RAILROAD GAZETTE

FRIDAY, DEC. 22, 1893.

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Contributions.

The Berkinshaw, Fish-belly Rail in America.

ST. LOUIS, Dec. 16, 1893.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Referring to the illustrations of track in the *Gazette* of Dec. 15, it may be of interest to know that the curious form of rail shown in fig. 5 was in use at one time on a branch of the Boston & Providence, between Readville and Dedham, Mass. It was in 1861 that the writer, then a boy, saw the rail in a side track of the branch above mentioned. In 1883, the writer, then Engineer of Maintenance of Way of the New York & New England, discovered a piece of the rail in a scrap pile of a dealer in railroad scrap in Cambridgeport, Mass., and, on inquiry, learned that it was received with a lot of mixed scrap rails from the Boston & Providence.

N. W. EAYRS, *M. Am. Soc. C. E.*

The Johnstone Wood Burners.

MEXICO, Dec. 11, 1893.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In reading the article in your paper of Nov. 24, on the wood-burning boiler used by this road, I notice two errors which may mislead some young designer.

In speaking of the crown bolts, you say a large washer is placed next to the sheet, under the end of the spacing ferrule of 1¼-in. pipe, so as to provide a larger bearing surface on the sheet. This is an error, as the ⅛-in. washers which you notice on the drawing are copper washers which go under the nut and make a joint between the nut and the upper side of the outer shell. The 1¼-in. pipe, which forms the spacing piece between the crown sheet and the shell, bears directly upon the two sheets at either end. It is important that all spacing ferrules should be as small as possible so as to cover up the least possible amount of crown sheet, allowing the water in boiler free access to the surface of the sheet.

In speaking of the stack, I see you have made the error of supposing that there is a horizontal netting over the cone. Perhaps the drawing does not show this very clearly, but the 24-in. opening just over the cone is perfectly free and has no netting. The shape of the cone gives the sparks a rotary motion, the heavy sparks continuing to revolve around the upper part of the stack until they are sufficiently pulverized to pass through the netting, which is only 10 in. wide. The gases have the full 24-in. opening through which to pass. We have found this stack particularly well adapted for burning wood. If, on account of the foaming of the engine, the netting becomes stopped up, we still have the 24-in. opening, and there is but slight obstruction to the draft caused by the stopping up of the netting.

This is by far the most successful wood-burning stack that I have ever seen, and I think we have tried more than 150 different styles in the last 10 years.

F. W. JOHNSTONE, *Supt. M. P. & M.*

Am. Soc. C. E.—The Canvass for the Secretaryship.

We are requested to publish the following card as a matter of personal explanation.

179 *Washington street,*
BROOKLYN, N. Y., Dec. 14, 1893.

TO THE CORPORATE MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS:

The intended meaning of the certain clauses in a letter relating to the Secretaryship of the Society, addressed by me to a small number of members and kindly included in a late circular issued by Mr. John G. Van Horne, having been misconstrued, and it erroneously inferred that thereby reflections were cast on the nominating committee and its nominee for secretary, I herewith disclaim such construction, either direct or implied.

The nominating committee doubtless acted after deliberate consideration, upon the fullest knowledge, and with the wisest judgment it possessed; composed of members, each not less than my peer and some at whose feet I would humbly sit, I did and could not question the method or candor of its decisions.

I earnestly advocated the appointment of Mr. Hunt as Assistant Secretary, insisting that the incumbent "should be a member of the Society in one of its higher grades, a man competent to discharge in all respects the duties of Secretary and understood to be in training therefor." Fully complying with these requirements he has in this capacity been capable and efficient; that in the position he now occupies he should be adversely criticised, or that in any material way he was a party to his nomination, I do not believe; quoting from a circular letter lately written by Mr. John Thomson, so far as I know, "his attitude . . . . has been manly, frank and to his credit."

The important question—Shall, under the circumstances, now well made known to the members, the assistant replace his principal?—remains to be decided by the ballot for officers of the Society. Confident that each vote will record a deliberate and unprejudiced choice for Secretary, and that the result will tend to promote the harmony, welfare and growth of the Society, I am,

Respectfully, G. LEVERICH.

A Man with a Conscience—and Sense.

TOLEDO, O., Dec. 14, 1893.

TO THE EDITOR OF THE RAILROAD GAZETTE:

The letter, of which the following is a copy, was written and addressed to my trainmaster when I was superintendent of the Lansing Division of the Lake Shore road in 1889. The circumstances attending the accident which called forth the letter are as remarkable as the letter itself. A passenger train, consisting of engine and three coaches, was approaching Jackson at a speed of 25 or 30 miles an hour, and on rounding a curve through a cut, across which were several street crossings at grade, a horse attached to a phaeton containing two ladies and two little children was driven on to the track and struck by the train. The horse was detached from the phaeton and instantly killed, but, strange to relate, instead of overturning the phaeton, it simply reversed its position on the highway, so the hind wheels tore cleats from the side of the smoking car, and did not upset. And when the train stopped, some three or four hundred feet from the crossing, the occupants of the phaeton were getting out, and were unharmed. The train proceeded, and every occupant thereof was thankful that providence had saved the lives of the occupants of the carriage. It was reported that no one was injured, and no immediate steps were taken to interview the parties. The section foreman, however, in disposing of the horse, as a part of his duties presented the owner, Mr. W., an "owner's claim blank" to fill out. He declined to do so, and noted thereon that his claim would be for destruction of property and great bodily injury to parties through gross fault of company's employes. That seemed very serious, and we at once began to investigate the "bodily injury" referred to, and in the course of the investigation called on the owner for a statement, as was customary in all cases of personal injury. Three or four days after the accident I went to Jackson, arriving there at 9 a. m., and my trainmaster had received that morning from the owner the letter referred to. It had been written the same morning. It has no parallel, and I thought you might wish to publish it. Of course, you will leave out names and places to destroy identity.

T. F. WHITTELSEY, *Gen'l Supt. T. & O. C. Ry.*

THE LETTER OF THE OWNER.

You asked me for a statement relative to destruction of property and injury to occupants of carriage at recent accident at crossing of Milwaukee street, this city. . . . At time the accident occurred I consented to act for all parties concerned (except railway company). The property destroyed was my own, and the occupants of the carriage were my son's wife, her two small children and Miss ———, who was the driver. I stated to a railway employe, who applied to me for my claim, etc., that the claim would be for destruction of property and great bodily injury to parties through gross fault of company's employes. My position at that time I still deem to have been proper, because it furnished foundation for whatever claims the facts might warrant me in afterwards presenting, and at the same time would do no great harm should I afterwards find no good cause of action on my own part or in behalf of others. In such cases as the one in question, the driver of a horse and the driver of a locomotive feel themselves, in a certain sense, immediately on trial, and both naturally seek exculpation. I heard many versions and was not willing to immediately commit myself in a statement to the railway company. Nature has not endowed me to think quickly, but I try to draw correct conclusions after carefully summing up all obtainable facts.

The crossing where the accident occurred belongs to the railway company and the public at large in common, but each with due regard to the safety of themselves and others. I have now learned so much as adjacent witnessing parties knew, and have tried to get all loose statements down to facts, and have placed myself in the exact position of the occupants of the wrecked carriage, and have gone over the ground just as they did, and I am forced to the conclusion that the occupants of the carriage, and particularly the driver of the horse, were inexcusably negligent. It is true the wind was blowing sound away from, instead of toward them, and they may not have heard the train, or they may have heard it without minding it because of familiarity, etc., but they surely were not blind, and from a carriage seat the cars are sufficiently visible from almost, if not quite, every point on the highway from the residence gateway to the crossing to give warning, and from a point 20 ft. south of railroad track; all the railroad track is plainly visible from the highway for about a mile to the westward, and from this point in the highway 20 ft. south of track until the track is reached and passed there is no obstruction of the view, and a single glance to the westward before reaching the track could not have failed to reveal the train to the occupants of the carriage. The driver of the horse simply ignored the fact of a railroad being there.

I go to the occupants of the carriage with no harsh censure. They feel badly enough and have my sympathy, and if any ask how they could do such a thing, I answer they did so from the same lack of care and discretion that generally causes the death of many railroad employes by their own trains. It is difficult to explain all the irrational things done in this world. The engineer in the case we are considering has been personally well known to me for nearly 20 years. I have not seen or communicated with him since the accident, but I know him to be a temperate and careful man. I doubt not I know him better than the officers of the road in whose employ he is. His career as a railroad engineer has been a long, and on the whole a successful one; in nature kind, he would sooner risk his own life to save others than recklessly do them harm. It cannot be said, therefore, that the engineer of the train was not in good hands.

You may think my findings peculiar under the circumstances, but whatever is, *is*, whether it pleases us that it be that way or not. Nevertheless, I am not unmindful of the ways of the world, and could very probably so prepare, present and manipulate a case as to secure damages at the hands of a jury, and I have been voluntarily waited upon by a well known attorney who has proffered his services on the terms of no pay if not successful, but it has been a rule of my life that no case under my control shall ever go to others to decide until it has first been tried under the criticisms of my own sense, and then whatever I do is done in the line of what I deem my duty.

I hardly agree with the attorney referred to, that whatever can be got out of a railroad company is legitimate. The only question for me to decide in the case is whether there is anything honorably my due. Taking all into consideration, I do not think there is. The loss for horse, harness, carriage, etc., is as near two hundred and fifty dollars as I can estimate, but I shall make no claim whatever. There might possibly be some little merit in a claim of higher speed of that particular train in vicinity of place of accident than was compatible with safety, and of this the officers of the railroad company can judge better than, or as well as I. When the running of trains was established on that road there was only one crossing between Belden and Francis streets, now there are three; and at the time referred to there were only five houses in city limits between Belden and Francis streets; now there are 68, including one schoolhouse, with children having to cross and recross the tracks, and what may have been proper when established, may be a just subject for revision under the changed circumstances.

While I think it not important, still if the company wishes I will procure a written release of any claim on the parts of the occupants of the wrecked carriage and this paper is a sufficient disclaimer for myself. I am sure I shall never receive anything unless the officers of the company with more information than I have, and with just intent find the company in something at fault. If this should be so, it will be on grounds that they can see because of more knowledge of this particular case and greater familiarity with such matters in general.

H. W.

The Haarmann-Vietor Track.

CHICAGO, Dec. 13, 1893.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I have read with great interest the article of Mr. Charles Paine on continuously supported rails, especially illustrating the Haarmann Vietor system, which appeared in your issue of Nov. 3, as well as Mr. T. C. Clarke's article on The Future Railroad, published in your issue of Nov. 17, and I would now beg to offer a few comments.

There are two kinds of systems of "continuously bearing rails," each radically different in principle. The one shows comparatively light and weak rails (similar to such as are in common use with crossties), fastened on longitudinal sleepers. The other kind or group shows rails *without sleepers*. In this latter case the rails have a section large enough to secure the necessary stiffness and to offer the needed bearing area to allow of dispensing with sleepers. Both groups of continuous systems are represented in the "Museum of Permanent Way," which the Georgs-Marien Bergwerks und Hütten-Verein has been exhibiting in Chicago by a number of constructions.

The constructions of the first group—requiring longitudinal sleepers—are faulty in many respects, as was evidenced by trials extending over a number of years. They lack in rigidness, and in time a good deal of wear takes place between sleeper and rail as well as on the clamps and other fastenings, and it is hardly possible to make the rail joints much stronger than in the cross-tie system.

In this respect the second group of so-called self-bearing rails differs materially from the above. The rails possess, if properly constructed, such remarkable strength and stiffness that a weighted axle can hardly cause a measurable indentation of the track at the weighted point. Herein lies the strength of these self-bearing rails. While each weighted axle of a train causes a wavy indentation of the track over which it rolls (and in consequence thereof high maintaining expenses) where comparatively weak rails have been fastened to crossties or longitudinal sleepers, this is not the case where the rigid heavy self-bearing rails have been

called into use. Of still greater importance, however, is the fact that the latter admit of that excellent rail joint which was commented on in the above-named article.

While with the still prevailing cheapness of wooden crossties in America a wooden crosstie system, such as is indorsed by Mr. Clarke, may be less expensive than the heavy self-bearing rails, convincing and exhaustive trials have yet to be made. Catalogue No. 62 of the museum, which has been exhibited in Chicago, showed such a wooden crosstie system with my scarf rail. The ties had a length of at least 10 ft., and the rails weighed about 76 lbs. to the yard. Two tie-plates were fastened to each tie with wooden screws in just the way suggested by Mr. Clarke. Whether, however, the one system or the other is to be preferred, whether self-bearing rails or wooden crossties with scarf rails, proof most practicable, the main point, always remaining, is the good construction of the rail joints, and a permanently good and strong joint can only be obtained by scarfing the rail ends.

The Haarmann compound, self-bearing rails have given the greatest satisfaction during the last 10 years, principally because the expense of maintenance is so infinitely small, and the German railroad administration appreciate this fact by gradually adopting the system.

In connection with these remarks it may be of interest to the readers of the *Railroad Gazette* to become acquainted with a letter which the Chief of the Transportation Department of the World's Columbian Exposition has addressed to me as the representative of the "Georgs-Marien Bergwerks und Hütten-Verein."

DR. ALWIN VIETOR.

CHICAGO, Nov. 20, 1893.

DR. A. VIETOR, ETC., ETC.—I desire to express to you, and through you to the great company which you represent, in a more formal manner than I have hitherto done, the thanks of the World's Columbian Exposition and of the railroad men of America for your admirable historical exhibit of railroad track or permanent way. The wonderfully complete character of the exhibit and its excellent arrangement were subjects of favorable comment on the part of intelligent visitors all through the continuance of the Exposition. It has been the strongest possible confirmation of the German reputation for sincerity of purpose and thoroughness of work.

The enterprise shown by your company in gathering together so large and complete a track museum, and the great care given to secure historical accuracy, are worthy of commendation. . . .

The result of your exhibit at the World's Columbian Exposition has been to inspire railroad men and manufacturers with a profound respect for your intelligent and scientific business methods and of gratitude for the education you have given them in the history of the development of railroad track.

I believe that another result of great importance will be to lessen the amount of reinventing of devices which have been already experimented with, some of them many times and in many places.

This waste of time, money and intellectual effort has been very great, in this country at least. Attention has also been called to your system of permanent way, and a considerable discussion elicited on the comparative merits of continuous bearing rails, which I hope will result in giving them a thorough and exhaustive trial.

The great object of the World's Columbian Exposition has been to educate. This has been the supreme aim of the Department of Transportation exhibits I deem myself happy in having secured so many earnest and sympathetic coadjutors, who have helped me to achieve such a high degree of success. Among these there have been none whose work has been as disinterested and at the same time as valuable as that of Director Haarmann, Dr. Vietor and the great company which they represent. Please accept this assurance of high appreciation and believe me

Sincerely yours,

[Signed] WILLARD A. SMITH,
Chief of Department of Transportation Exhibits.

The answer to this letter runs as follows:

CHICAGO, Dec. 2, 1893.

WILLARD A. SMITH, ESQ., Etc., Etc.—In acknowledging receipt of your letter of Nov. 20, I desire to express my thanks, and the thanks of the firm which I represent, for your extremely kind words. Above all others Director-General Haarmann will find great satisfaction in your high appreciation of the value of the collection of sections of track which he sent to the World's Fair of Chicago and the Georgs-Marien Bergwerks und Hütten-Verein will in the presence of such results be glad to have made the sacrifices of time and money which were entailed in sending the museum to this country.

Furthermore, I am convinced that the contents of your writing will not only be of great interest to German railroad men, but will be convincing proof to them that practical and expert American railroad engineers of the highest standing fully appreciate any sincere work done toward thorough historical research in behalf of the future development of the business of railroading.

If in the hearty co-operation of all parties interested alone can be found the guaranty of ultimate success, then I dare hope that the praise which you have for our "Track Museum" will be instrumental in bringing about a closer coworking of American and German engineers in their efforts toward producing a railroad track as near to perfection as possible. Very sincerely yours,

[Signed] DR. ALWIN VIETOR,
Chief Engineer, Georgs-Marien Bergwerks und Hütten-Verein.

Pneumatic Interlocking at Buffalo.

The crossing of the Delaware, Lackawanna & Western and the Western New York & Pennsylvania railroads in Buffalo, N. Y., has for several months been equipped with signals operated by a novel interlocking machine made by the Auto-Pneumatic Railway Signal Co., of Rochester, N. Y., and the drawings printed herewith show the general arrangement of the apparatus. All the operations are performed by means of air pressure or gravity, no electrical apparatus being used and no manual power except that necessary to turn the air on and off. The signals are ordinary semaphores. They are moved to the all-clear position by air pressure, operating on a piston in a cylinder fixed to the signal post, and are moved to the danger position by counterweights when the air pressure is withdrawn, as is the case with the Union Switch & Signal Co.'s automatic signals. Derailing switches in connection with each home signal are also operated by air pressure.

The interlocking is accomplished wholly by means of a seven-way valve in the tower, and all movements are therefore made with one lever. The most radical difference between this and the ordinary apparatus at a crossing is in the simplicity of the interlocking, the westbound and the eastbound signals of the Lackawanna road being cleared simultaneously, and the same course being followed with the signals of the other road.

Fig. 1 shows the general arrangement of tracks. The tower contains, besides the operating lever, a small air pump, which, with its boiler, is fixed upon the second floor, where the signalman can conveniently attend to it. Outside the tower is an air tank about 4 ft. in diameter, with a capacity of 75 cu. ft. On the Western New York & Pennsylvania, approaching from the north, which is at the lower side of the drawing, there is no distant signal, this being the yard of that road, but in each of the other three directions there is a distant signal, located as follows: East, 500 ft. from home signal; south, 812 ft.; west, 395 ft. The speed of all trains at this point is moderate, so that there is no need of placing these signals farther away.

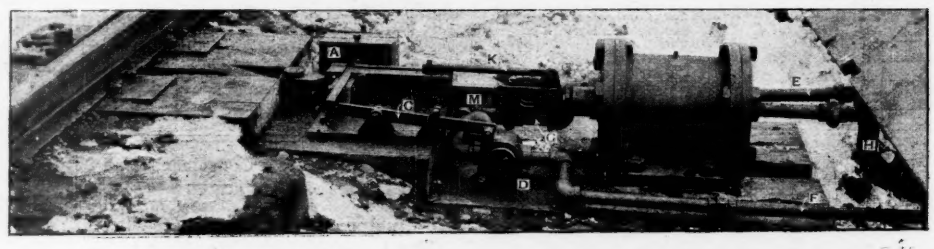


Fig. 5—Pneumatic Apparatus for Derailing-Switch.

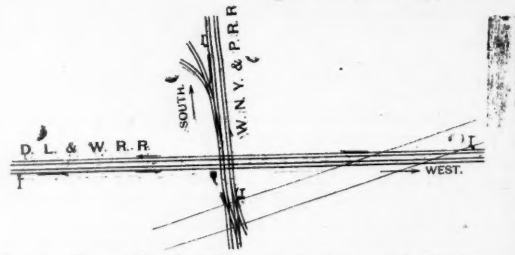


Fig. 1—Plan or Crossing, Delaware, Lackawanna & Western and Western New York and Pennsylvania Railroads.

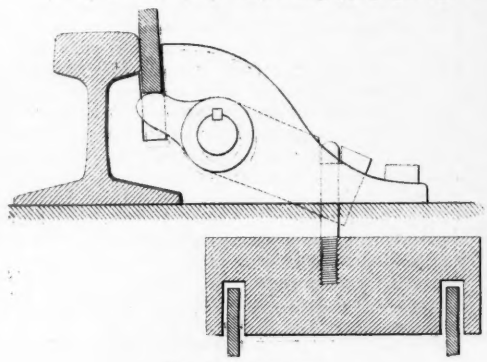


Fig. 7—Safety Shoe.

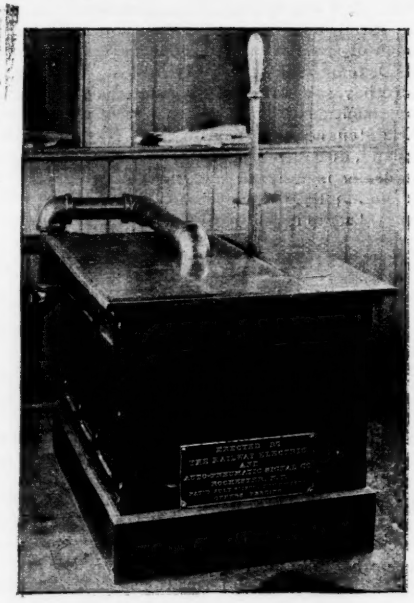


Fig. 6—Operating Lever for Single-Lever Interlocking.

PNEUMATIC INTERLOCKING AT BUFFALO.

The arrangement of the air pipes is shown in fig. 2, the tracks being omitted from this drawing, except so far as is necessary to show the derailing switches All distant signals are operated simultaneously with the home signals. The pipes shown in heavy lines are for setting signals and derailing switches. Those shown in dotted lines are smaller and their office is to lock the operator's lever. Just inside each home signal is a "shoe," described below. This shoe is fixed close to the outside of the rail like a detector bar, and when depressed by the passage of wheels opens a valve which admits air to the pipes mentioned (dotted line) and moves a small piston so as to lock the operating lever. As will be seen by the drawing, there are two of these pistons, one on each side of the operating lever, and a train passing any one of the shoes will lock the lever so that it cannot be moved to close derailers or clear signals conflicting with that route. The shoes are long enough to reach from one truck to another of the longest car; so that when once depressed they remain so during the passage of the entire train.

The operation of the signals can be readily understood by following a single operation, say the clearing of the signals for the Delaware, Lackawanna & Western, which is the horizontal line in the diagram, fig. 2. To do this the operator turns the lever to the right, so that air pressure (10 lbs. per square inch) flows from the reservoir through *e*, *f*, *g* to *h*, opening the derailing switch on the conflicting route; to *k*, *m* and *n*, performing a similar office, and to *o* and *p*, closing and locking the derailing switches on the Lackawanna tracks. The air pressure after moving these last two switch pistons continues on in pipe *o* throwing signal *r* to the clear position, and through pipe *p* throwing signal *s* in the same manner. The pressure cannot reach the signal before it locks the derailer, for the latter has a controlling valve, which will be presently explained.

Fig. 3 shows a plan by which a more complicated arrangement of signals can be operated by pneumatic pressure. This plan has been devised to provide, for instance, for a crossing of two southbound and one northbound tracks with one eastbound and one westbound, with separately worked signals for the opposite directions on the same line. The additional interlocking is provided by means of the additional levers, in connection with the sliding valves shown immediately beneath the levers in the upper left hand corner of the drawing. The sliding valve is shown on a larger scale in fig. 4. In fig. 3, tracks 1 and 2, represent a double track east and west road, tracks 3 and 4 a double track north and south road, and track 5 a single track north and south road. The levers, numbered to correspond with the tracks, all stand in the danger position. To clear the signal for track 1 the lever is turned 60 degs. to the left, admitting air from the reservoir through pipe *a* to derailing switch *c* 1, to signal *s* 1, and the corresponding distant signal; also through sliding valve *k* 1, pipe *a b*, to derailing switches *c* 3, *c* 5 *b*, *c* 4 and *c* 5 *a*. These derailing switches thus being all open, their corresponding signals must stand at danger.

To clear the signal for track 2, lever 2 is pulled over, admitting air through pipe *b* to derailing switch *c* 2 and the corresponding signal, *s* 2. At the same time air enters sliding valve *k* 1 and thence through pipe *a b*, as in the preceding movement, the tracks conflicting with signal 2 being the same as in the case of track 1.

To clear the signal for track 3, air is admitted to pipe *c*, the action being the same as in the movement just mentioned. If this should be attempted before levers 1 and 2 had been returned to the danger position cylinder *c* 3 would be immovable, on account of the pressure in it from pipe *a b*; but assuming that 1 and 2 have been restored to the normal position the pressure in pipe *c* operates cylinder *c* 3 and signal *s* 3. The air from pipe *c* also goes through sliding valves *k* 2 and *k* 3 to pipe *c d e*, and opens the derailing switches at *c* 1 and *c* 2, these being the only routes that conflict with track 3.

In clearing track 4, air enters at the right hand of *k* 2. If signal 3 is still standing at clear, the piston in *k* 2 will

not be moved; but such movement is not necessary, because the derailing switches in the routes conflicting with track 4 are already opened.

In both of the drawings the dotted lines represent pipes leading from the reservoir to the locking cylinders which control the levers, and the operation of this lock is controlled entirely by the valve attached to the shoe or detector bar. Referring to fig. 2, when a train passes over the shoe *X*, on the westbound track, it admits air from the reservoir through pipes *v* and *w* to the lock at the left side of the cylinder. This prevents clearing the signals or closing the derailing switches on the conflicting route, but it does not prevent the movement of the lever

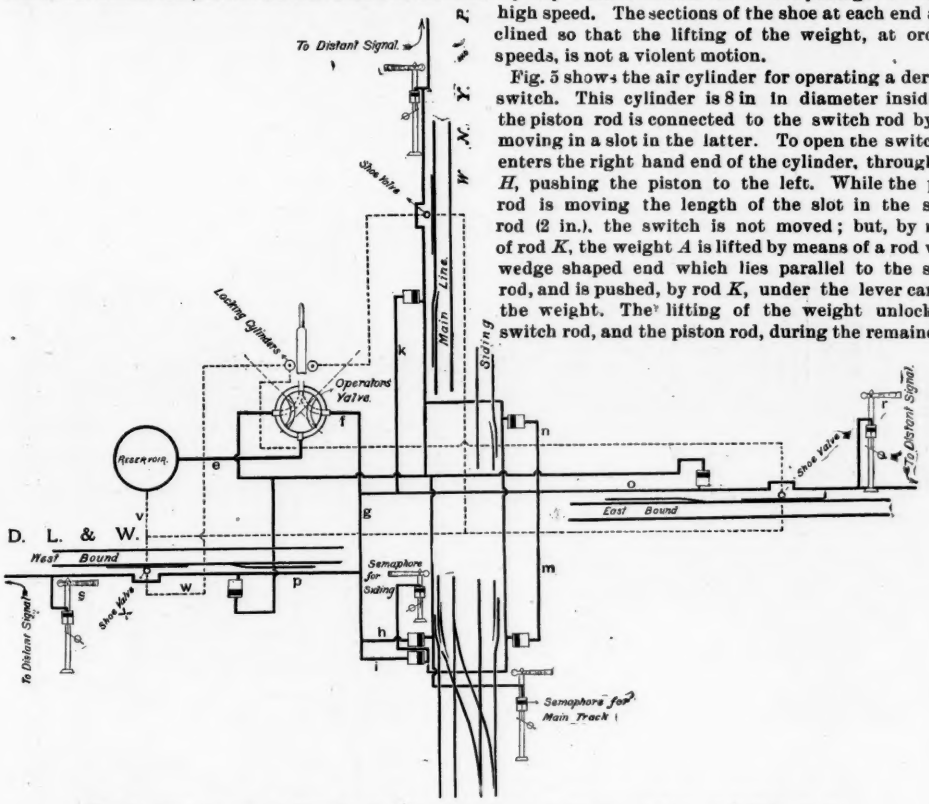


Fig. 2—Arrangement of Signals, Derailing-Switches and Air Connections at Buffalo, N. Y.

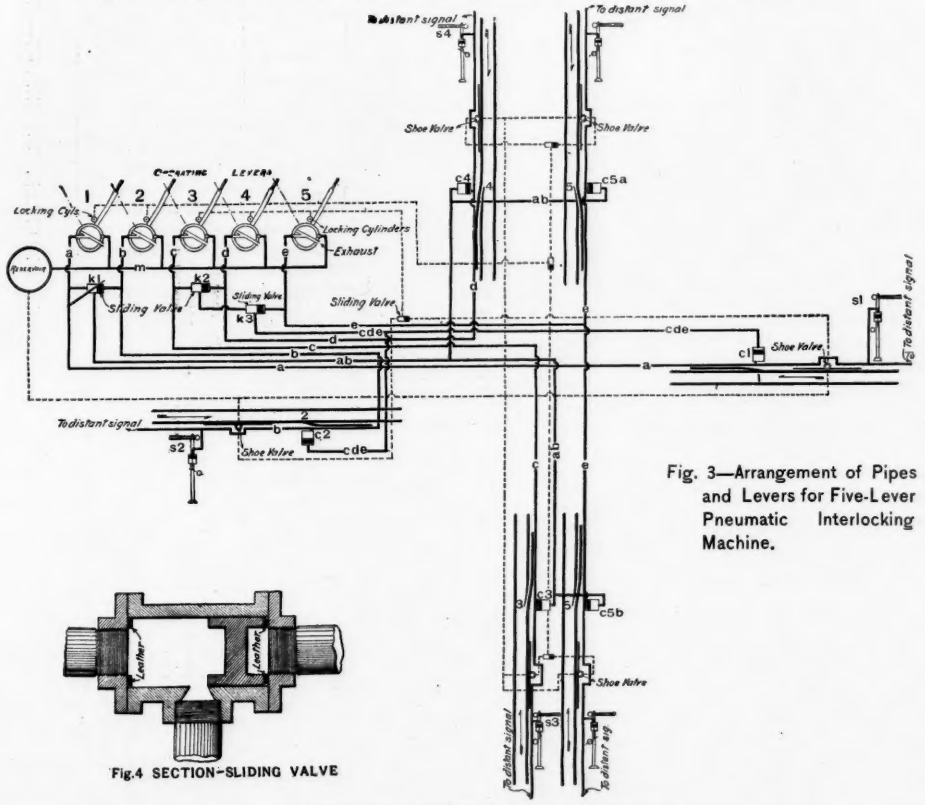


Fig. 3—Arrangement of Pipes and Levers for Five-Lever Pneumatic Interlocking Machine.

Fig.4 SECTION—SLIDING VALVE

PNEUMATIC INTERLOCKING APPARATUS.

to the vertical position and throwing signals *s* and *r* to danger, if desired, before the train has wholly cleared the shoe.

The shoe consists of a series of detector bars held by suitable braces against the outside of the rail. Each bar rests on two arms which are fastened to a shaft lying parallel with the rail and with the bars. This shaft turns on its axis and is counterweighted so that in its normal position it supports the bars in a position ¾ in. higher than the top of the rail. A train passing over the bars depresses them, rotating the shaft slightly and lifting the weight. Near the center of the shaft is a weighted arm which when in its normal position (down) allows the weight to rest on the stem of a three-way seat valve, in the air pipe, holding the valve closed. When the weight is lifted by the passage of a train and the rotation of the shaft, the valve is forced upward by the constant air pressure from the reservoir, and a passage is opened between the reservoir and the locking cylinder, as before described. When a train passes off the shoe the weight drops, closes the valve, exhausts air from pipe *W* (fig. 2), and the piston is withdrawn by a spring, freeing the lever.

Fig. 7 shows a cross section of the detector bar and lever. It will be observed that the movement of the shoe has no connection with the valve except to lift the weight off from it. The valve is therefore unaffected by any violent motion due to the passage of a train at high speed. The sections of the shoe at each end are inclined so that the lifting of the weight, at ordinary speeds, is not a violent motion.

Fig. 5 shows the air cylinder for operating a derailing switch. This cylinder is 8 in in diameter inside, and the piston rod is connected to the switch rod by a lug moving in a slot in the latter. To open the switch, air enters the right hand end of the cylinder, through pipe *H*, pushing the piston to the left. While the piston rod is moving the length of the slot in the switch rod (2 in.), the switch is not moved; but, by means of rod *K*, the weight *A* is lifted by means of a rod with a wedge shaped end which lies parallel to the switch rod, and is pushed, by rod *K*, under the lever carrying the weight. The lifting of the weight unlocks the switch rod, and the piston rod, during the remainder of its motion, pushes the switch open. The lifting of the weight, which, as will be seen, must take place before the switch can be opened, throws the signal to danger if it is not already in that position. This is done by means of the three-way valve *D*. As the weight is lifted the valve is turned, by means of lever *C*, so as to close the passage from supply pipe *E* to pipe *F* leading to the signal, and at the same time an opening is made from *F* to the atmosphere.

To close the switch, air is admitted to the left hand end of the cylinder, from the tower, through pipe *E*. The movement of the piston closes the switch, and as it nears the end of its stroke it pulls the wedge out from under the weighted lever, allowing the latter to drop into a notch in the switch rod. At the same time the valve *D* is turned so as to open connection between *E* and *F*, clearing the signal.

Fig. 6 shows the appearance of the operating lever in the tower at Buffalo.

All of the apparatus described has now been in use several months, and the officers of the Lackawanna road say that it fulfills its promises. Experience shows that the parts are of suitably simple and durable design. The air pressure used is only 10 lbs. per square inch. With this pressure about 17 cu. ft. of free air is required for each change of signals, and the signals move in about 4 seconds after the air is turned on. The storage tank holds about seven times the capacity of one set of pipes, so that an operation reduces the pressure but slightly, while the air remains in the reservoir long enough to resume its normal temperature before being let into the pipes. This, with the low pressure used, has thus far obviated any trouble from condensation of moisture in the pipes.

The officers of the company are: Dr. J. H. McCartney, President; George Weldon, Vice-President; T. A. Smyth, Secretary and Treasurer, and Frank L. Dodgson, Chief Engineer.

Recent Progress in Steel Castings.

At the New York meeting of the American Society of Mechanical Engineers, held this month, Mr. H. L. Gantt, Superintendent Casting Department, Midvale Steel Works, Philadelphia, Pa., presented a short paper on Recent Progress in the Manufacture of Steel Casting, which was peculiarly interesting. He said that only a few years ago the ordinary steel casting was a rough chunk composed of about equal parts of steel and holes, and anyone who is familiar with the results knows exactly what he meant by that description; but to-day a steel casting is subjected to a more rigid inspection for cracks and holes than an iron casting and the general appearance is required to be nearly as good. Very few years have elapsed since this became a serious industry. It was only in 1886 or '87 that the Midvale Steel Company made soft steel castings for gun carriages, which were subjected to ballastic test, but steel castings had been made in this country as early as 1867, when the William Butcher Steel Works, now the Midvale Steel Works, made some crossing frogs for the Philadelphia & Reading of crucible steel. These are said to be still in use. The surface of the casting was very smooth, the metal being practically tool steel; but silicon had not begun to be used and the castings were much honeycombed except the wearing surfaces which were "cast down." In 1876 two small hammer dies were made of open hearth steel at the same works, and a month later a hammer head weighing 2,535 lbs. was made. One direction in which improvement was made in these years was in the molding mixture. In 1867 it was ground fire brick, ground black lead crucible pots and fire clay washed with a black lead wash. On large castings made with that facing the surface was very imperfect, and the sand adhered with great tenacity; and while the quality of the steel was greatly improved the appearance of the castings was always against them. The next step was to leave out the ground pots and to wash the mold with finer ground fire brick, but the mixture still clung so strongly to the casting that only simple shapes could be made with certainty. Then a mixture of silica, sand and flour was used, but the flour burned out, often leaving the mold so brittle as to be useless, and eventually a mixture, of which the principal constituents were silicia sand and molasses, was used. Meantime, the use of silicon for solidifying the castings became common. This brought the art up to what it was in 1887 when the Midvale Steel Company made the first gun carriage castings of steel, but at that time the necessity for using the metal hot did not seem to be understood and blowholes were common. It was gradually learned that hot metal was needed to make solid castings, and that small castings needed hotter metal than large ones.

We shall not follow Mr. Gantt in his explanation and of the reasons why hot metal is especially desirable. The observance of the rule that a steel casting should be as far as possible of uniform thickness has made it possible to make castings 20 ft. long by 10 ft. wide, but only the initiated understand yet that it is more difficult to get small castings than large ones for the reason that most of them are made from open hearth steel and from melts of from 5 to 20 lbs.; that it is impracticable to pour small castings so rapidly, and that the latter ones are poured too cold. From this it follows that the use of a small Bessemer converter is the best way to get good light castings.

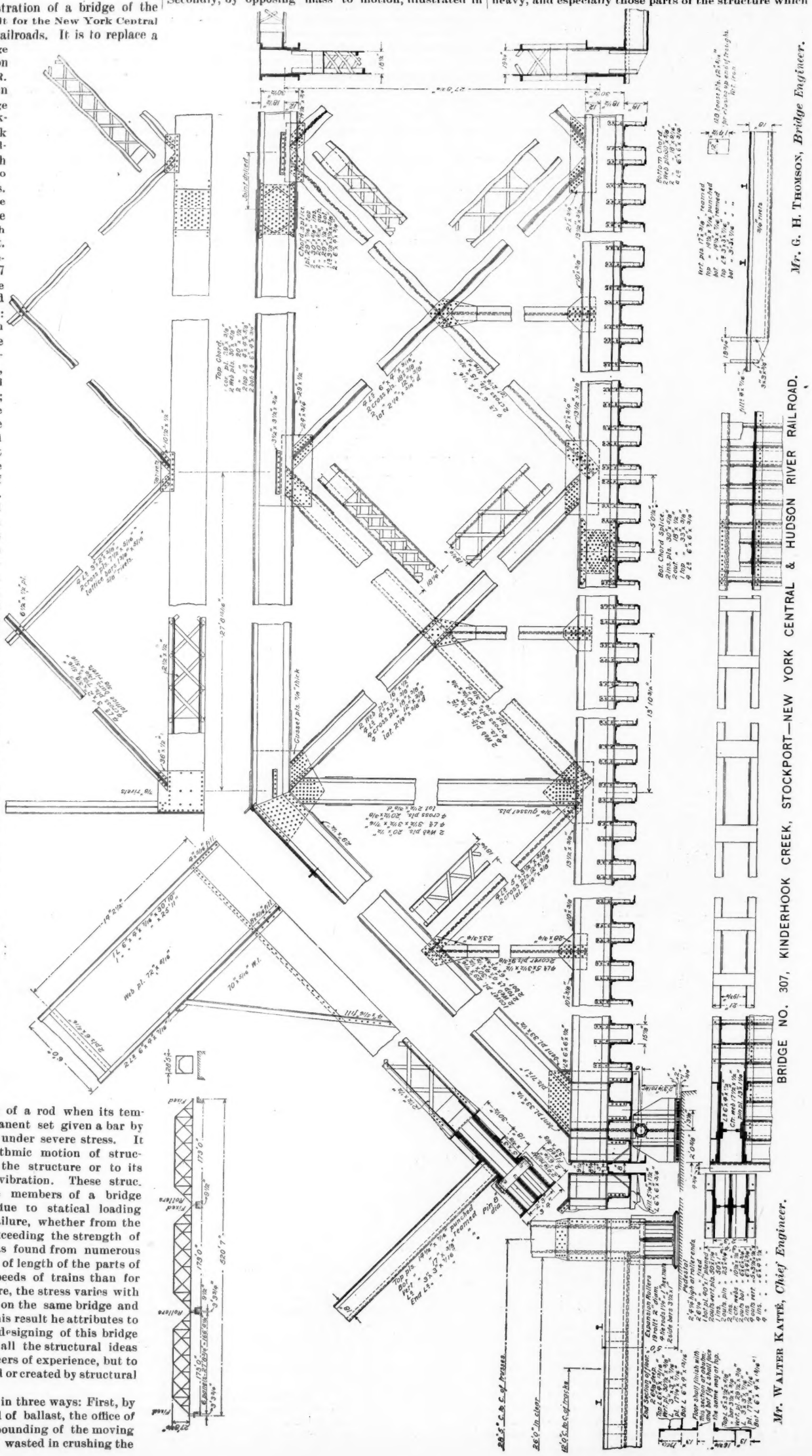
Among the other advances made in steel casting may be mentioned one for making a casting having one or more facings much harder than the body of the casting. This is done by lining the mold where it is desirable to harden the face of the product with a metallic alloy crushed or powdered which will be melted and absorbed by the melted steel in contact with it. The result is a product which may be readily hardened. If it is desired that the casting shall have a perfectly hard face for stamp shoes, hammer dies, etc., ferro manganese gives the best results. If it is desired to machine the surface and harden it afterward, ferro-chrome is most suitable. The fact that it is possible to produce a soft steel casting having a face that can be hardened without the rest of the casting becoming brittle will make it possible to use steel castings in place of chilled iron in many places.

Stockport Bridge and "Structural Motion."

Herewith is given an illustration of a bridge of the prevailing type recently built for the New York Central and the Central Vermont railroads. It is to replace a wooden Howe-truss bridge on the Hudson River Division of the N. Y. C. & H. R. R. R. which is the last wooden bridge on the road. The bridge is now being erected at Stockport, over the Kinderhook Creek, 26 miles south of Albany. There are three through spans of 173 ft. each, two trusses, carrying two tracks. The trusses are riveted lattice girders, double Warren type with subdivided panels, each subdivision being nearly 14 ft. in length, and the distance between chord centers being 27 ft., 8¾ in. The details are illustrated in the cut, and those of special interest are: The pedestals which are pin connected and on rollers; the solid trough floor and its attachment to the lower chord, the double overhead lateral system of latticed members; the heavy web members of the trusses and the use of a plate portal. The floor system had to be made shallow on account of high water which some times rises to the elevation of the bottom of the troughs. The superstructure is of acid open-hearth steel, made from inspected stock. The rivet holes in tension members are drilled, in compression reamed, except in the floor system where they are all reamed, and in the laterals and portal they are punched. The bridge weighs 1,000 tons and cost $73,000 including the erection by the company. The parts were manufactured by the Elmira Bridge Company, Elmira, N. Y., after the plans of Mr. G. H. Thomson.

In this bridge Mr. Thomson has essayed to correct the destructive effects of so-called "structural motion." Structural motion he describes as those movements or impulses of a structure (bridge) caused by the dynamical shocks and blows of a moving load, whether of a horse trotting over it or of a locomotive running at a high speed; the amount and character of the motions depending upon the magnitude and frequency of the blows, *i. e.*, upon the velocity with which the load moves. Mr. Thomson does not wish to confine his theories of structural motion to movements perceptible to the eye alone, but would include also those impulses to which matter is subject as between the fibers and molecules, the effects and results of which are apparent to the eye—as for example the lengthening of a rod when its temperature is raised, or the permanent set given a bar by a blow or shock when it is under severe stress. It should include also the rhythmic motion of structures, which is peculiar to the structure or to its members, sometimes called vibration. These structural motions create in the members of a bridge stresses in excess of those due to statical loading and are often the cause of failure, whether from the fatigue of the metal or from exceeding the strength of the material. Mr. Thomson has found from numerous experiments that the variation of length of the parts of a bridge is greater for high speeds of trains than for slow speeds, and that, therefore, the stress varies with the speed of the moving loads on the same bridge and under the same conditions. This result he attributes to structural motion, and in the designing of this bridge he has sought not only to meet all the structural ideas accepted as orthodox by engineers of experience, but to meet other contingencies caused or created by structural motion.

This has been accomplished in three ways: First, by cushioning the track on a bed of ballast, the office of the ballast being to absorb the pounding of the moving load, their kinetic energy being wasted in crushing the stone, which has to be renewed at frequent periods. Secondly, by opposing mass to motion, illustrated in making the floor system and entire structure unusually heavy, and especially those parts of the structure which


BRIDGE NO. 307, KINDERHOOK CREEK, STOCKPORT—NEW YORK CENTRAL & HUDSON RIVER RAILROAD.
Mr. G. H. Thomson, Bridge Engineer.
Mr. Walter Katté, Chief Engineer.

are subject to the distortive effect of structural motion, viz., the lower chord web and lateral members. Thirdly, by adopting a form of truss the least subject to structural motion, and by the introduction of auxiliary or even so-called redundant members to restrain rhythmic action. This last is accomplished by avoiding too long panels, or by subdividing them; by supporting or uniting flexible members to stiff joints and by stiffening the whole structure by continuing the system of counters to the end, or by carrying out a double system of trussing complete to the abutments. These features of design break up the persistence of structure motion and keep it within such limits that it has not a destructive effect.

The consideration of these features is necessary only as the structure is subject to live loads, and so far as structural motion is induced. In the bridge before us these features are supposed to be carried out. The track is laid upon wood ties, bedded in broken stone ballast, which is filled in the troughs; this mass of stone and iron is carried by a heavy lower chord which will be little affected by the motions and impulses of a heavy train. Mass and motion Mr. Thomson holds are "disparate and correlatively dependent, a greater mass will control motion," and although it may not be economy to absorb structural motion by the rational placing of steel at 3½ cents a pound, yet stone ballast may be employed, and the extra cost of supporting it met.

The panel points are close together and connected by a heavy girder for a lower chord which is supported in the middle by a stiff tension member. The double system of triangular girder is carried out to the abutments and the live load and the stresses induced by it are carried to the supports independent of the counteracting effects of the dead loads. Mr. Thomson aims to design the members of his bridges so that no part shall lengthen or shorten more than two hundredths of one per cent. of its length, or $\frac{1}{5000}$ of its length.

The determination of these questions unfortunately is not as yet reduced to a science, and the amount that the cross-sectional area shall be augmented, the mass to be added, and the subdivisions to be made and stiffening members to be introduced, are a matter entirely of judgment based upon observation of the structural motion in other bridges. Every practical bridge engineer has collected during his experience data and results on which to base his decisions, and it is believed that the time is not far distant when the engineering profession will take up the subject and determine and formulate the laws governing "structural motion." Until that is done the state of the art of bridge design will remain where it has been for many years—a theory, based upon statistical conditions.

The phenomenon of structural motion as usually manifest in bridges is characterized by the terms "shaky," "jumping," "vibrating," etc., while the absence of it is expressed in general terms as its "stiffness," "rigidity," "resilience" (?) etc. But these terms do not in Mr. Thomson's estimation comprehend necessarily the idea of structural motion. The fact that a bridge, for example a Howe truss, is stiff and not shaky is not conclusive evidence of its strength or of the absence of structual motion. He contends that the motion of a structure is not wholly a matter of stress per square inch due to statical loading, and that low unit stress does not insure freedom from structural motion. Bridges of heavy design have sometimes too much motion, and light structures are not by virtue of their lightness alone necessarily subject to a great deal of motion. A heavy bridge with long panels and without counters, except in the middle panels, may be very susceptible to motion, while the same structure could be much lighter but with counters throughout and have much less motion.

In conclusion the designer of this bridge expresses the belief that the doctrine of structural motion is certain to be recognized at an early day in engineering practice; and that, too, before much greater advance in structural art will obtain.

The Railroads to the Cripple Creek Mines.

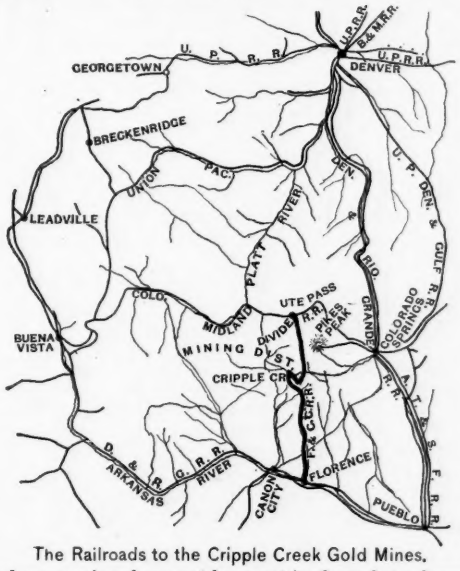
Cripple Creek, Col., is pretty sure to have two railroads of standard gage, to be completed and in operation early in the new year, one line extending from the north and connecting with the Colorado Midland, and the other from the south, joining the Denver & Rio Grande. The Midland Terminal company has this week completed its line to the town of Midland, nine miles north of the gold camp, and the Florence, Cripple Creek & State Line Railroad has survey stakes driven and the grading contract let. The former route has its initial point at Divide station on the Colorado Midland, extending by easy grades and curvature along the mountain ridges to Midland, thence by heavy grades down a cañon and over a ridge into the rounded hills where the productive mines are located. The latter route starts from the town of Florence, on the Denver & Rio Grande and Atchison lines, in the Arkansas Valley, and goes up through cañons and across one steep hill into the town, touching at the several big mines in passing. This route is 28 miles long, its sharpest grade being 3½ per cent., but this grade is for a small portion of the distance. Most of the route has no heavier grade than two per cent. The advantages claimed for this route are the abundance of water at Florence for mill purposes, the proximity of the best of steam coal and a short line to the smelters at Pueblo. The route passes through some fine quarries of marble and gypsum, some undeveloped coal lands, a heavily timbered region, and 15 miles of partially developed and prospected mining country. Reduction works of some magnitude are to be constructed at Florence to treat the ores. Mr. D. H. Moffat, the well known Denver mining man, is interested in this project, and through him over $500,000 has been subscribed in the East to carry on the work.

The Midland Terminal route is over the Colorado Midland to Colorado Springs, thence to Denver or Pueblo. The heaviest grades of the Colorado Midland are in the ascent through Ute Pass, where the grades are four per cent., and some of the curves quite sharp, but as the heaviest haul is to be on outward business, all this will be done on a down grade. In climbing out of Cripple Creek the Midland Terminal will have some heavy grades to overcome. There is no coal or water on the route of the Midland Terminal as on its rival line, and it must depend upon its tonnage out of Cripple Creek for its business, with little hopes of building up a local trade. The distances from Cripple Creek by these two routes are as follows:

Midland Terminal to Denver, 120 miles; to Pueblo, 90 miles; Florence, Cripple Creek & S. L., to Denver, 200 miles; to Pueblo, 80 miles.

The Midland Terminal has announced a rate of $1.50 a ton from Cripple Creek to either Denver or Pueblo.

Now as to the resources of the camp. In the absence of official figures, only estimates may be drawn. At the close of this year the camp has over 125 producing mines. The best estimate obtainable now is that the total yield of the camp in gold, dating from its discovery two years ago, has been $2,500,000. The tonnage is a matter of guesswork. The ore exists in great quantities, not only in the producing mines, but in the hundreds of partially prospected and developed properties. For more than a year there has been talk of a railroad,



The Railroads to the Cripple Creek Gold Mines.

and many mines have not been put in shape for a large output until this should be an accomplished fact. So many mines, however, have shipped out ore in wagons to the railroads and still made a handsome profit that it is reasonable to suppose the tonnage will be very large when the railroads reach the camp.

In this matter the cost of production at the present time is surprising. Few of the mines are of any great depth as yet, and the cost of production is in many cases as low as $1.50 a ton on ore that sells for $20 at the smelters. It is a conservative statement to say that the Victor ore yields a profit of $10 on every ounce of gold produced. That the camp is a permanent one there can now be no doubt. It may not develop so great a tonnage as some of the great silver camps of the state did in the past, but the ore is of such a character that it will pay a good rate on all shipped to smelters. For over a year tests have been made as to the quality of the ore. Now over a dozen free milling processes are in operation in the camp. Probably the best of the mills save no more than 75 per cent. of the assay value of the ore. Many ores so treated yield less than one-half the assay value. So far the chlorination process, so successful in Johannesburg, has not been found satisfactory in Cripple Creek, although it is but a question of time when the process will be adapted to the ores there.

Meanwhile, the most satisfactory process will be by means of smelting, and the plants in Denver and Pueblo will control the output and will be able to overbid any new plant located nearer the camp. The matter of tonnage to the railroads will depend upon the cost of production, transportation and treatment. Time alone can demonstrate what effect the railroads will have in stimulating development work.

Cripple Creek has now a population of 10,000 people and a payroll over $75,000 a month. It has a system of water works, a telephone line is building into the camp from Colorado Springs, and both the great telegraph companies do a rushing business. The camp has had a slow growth. Just at the time when the discovery of gold was announced there, some Denver mining men of means were finding the rich mines at Creede. The Creede boom attracted all the attention, and no men of means to develop the prospects went into Cripple Creek. Silver ore was still the much looked for article. Gold ore was not wanted. The very fact that men of means did not go into Cripple Creek was the best of reason why the reported discoveries should be doubted. Even in the face of smelter returns of ore hauled out over unbroken trails the resources of the camp were doubted.

However, with the opening of the present year enough development work had been done to demonstrate that gold in paying amounts could be obtained there. Experts were sent in, the railroad problems began to assume shape when the panic of the summer stopped all investments for the time. It turned the attention of the men of means to gold investments, and the latter half of the present year has shown most excellent results. With the railroads an established fact, and with 200 mines (a safe estimate) shipping ore, the year 1894 promises to show surprising results.

The Blackwell's Island Bridge.

As the project for a bridge across the East River at Blackwell's Island has assumed more definite shape, we give what information is to be had from headquarters. The bridge is to be built under the franchises of Dr. Rainey, which have been acquired by the promoters of the scheme. Mr. Austin Corbin, one of the prime movers in the project, gives assurance of the early preparation of the detailed plans for the bridge and its prompt construction. A company has been organized as the New York & Long Island Bridge Company and the following directors elected: James G. Gardiner, George W. Quintard, James R. Cuming, Jacob P. Miller, Daniel M. Rollins, Herbert C. Smyth, William J. Kelly, William G. Bosworth, Joseph H. Jones, George A. Hamilton, Henry M. Conover, Edward J. Boyle and James J. Noonan.

The project is a part of Mr. Corbin's scheme to bring the Long Island Railroad into New York and directly to the commercial centers of the city. To this end a charter was secured for an elevated railroad upon Second avenue which will be extended down as far as Twenty-second street and north as far as Eighty-first street. It is also hoped to have a cross-town line connecting the other elevated lines of the Manhattan system and the Grand Central Depot. The scheme is a part of a grander undertaking, to make some day a harbor for Transatlantic steamships at the extreme eastern end of Long Island which shall reduce the passage to Queenstown by several hours and avoid the necessity of the large passenger steamships passing around through The Narrows. Ships could then sail irrespective of the tides.

Nothing has yet been done toward the preparation or adoption of a design for this bridge. The civil engineer of the structure will doubtless be Mr. J. Vipon Davies, Consulting Engineer of the Long Island Railroad and engineer of the Consolidated Gas Company, which is now tunneling the East River. Certain facts, however, have been settled upon with regard to the bridge and its capacity. It will consist of three river spans and two anchor spans, supported by four steel piers. Two of these piers will be located upon Blackwell's Island inside the pier and bulkhead line, and one upon each shore, also within the pier and bulkhead line, leaving the full width of the two branches of the East River clear and unobstructed. The bridge will have 153 ft. of clearway above high tide and two water spans of 870 ft. each. The height of the Brooklyn Bridge is 135 ft.

The substructure will consist of solid masonry piers built upon the solid rock, which is slightly below the surface of the water. Little or no excavation will be required, for the rock outcrops here upon both sides as well as the island. In fact the bridge will pass almost directly over the Blackwell's Island quarries.

Nothing has been determined about the superstructure except its span, and that it will be of the cantilever type, this being adopted because it may be constructed without obstructing the river with falseworks. The approaches will consist of steel towers with girder spans and will be built upon private property for some distance inshore. The New York approach will be continued on Sixty-fourth street to First avenue, where it will divide, one line going north on First avenue, extending to Eighty-first street, the other south to Forty-fourth street, at which streets it will be at grade. The approaches on the Long Island side will extend from the river to Sunnyside, where the line will connect with the main line of the Long Island Railroad. The bridge is to be double-decked, one deck being for two railroad tracks and the other for double wagonways as well as footways. It is proposed to run the regular cars of the Long Island Railroad over the bridge, not only passenger but also freight cars; and a freight station is to be established at Eighty-first street at the end of the approaches. The regular locomotives of the road will be run directly across the bridge. The total cost of the bridge and its approaches and the terminals is not to exceed $10,000,000. The consents of the Secretary of War and the municipal authorities of New York and Long Island Cities have been obtained, and the projectors assure us that as soon as specifications and plans can be prepared the contracts will be let for its construction. The time fixed for its completion is by January, 1897.

Negotiations are said to be in progress for the leasing

of the Columbia Iron & Steel Company to the Elmira Bridge Company, the Elmira Iron and Steel Company and the Jackson Architectural Iron Works of New York City, the object being to enable these New York companies to take the contract for building the East River Bridge; but this must be taken carefully until substantiated.

Railroad Matters in Chicago.

Freight Traffic.—There was a fair outward movement of Western freight the past week. While the amount failed to reach the liberal volume of the second week in December last year, the deficiency was less than had been expected. There was also a surprisingly good week in inbound traffic. The receipts of grain by the 11 leading lines show an excess of 1,474,000 bushels over the week immediately preceding, and aggregated 4,705,000 against 3,565,000 the corresponding week last year. The Car Accountant of the Chicago, Burlington & Quincy said: "Our business from the interior (grain) shows a surprising increase, and for the first time in months we are short of cars. The trouble is that we allowed our cars to go east with through grain for the seaboard, and the old story of their slow return is repeated." The officers of some of the other big lines which have been less accommodating to their Eastern connections, said that while their inward business was improving, they were well supplied with cars and could handle a much larger traffic than had yet appeared. They would be satisfied if their traffic the coming few weeks reached the customary average for the season. A comparison of reports with those of a year ago shows that with the exception of Minneapolis and Duluth, the grain traffic at other Western points was in excess of the same time last year. It seems likely, however, that as the bulk of the increase was on coarse grain, a portion of it was through business, stimulated by the cut rates. If such is the case, the movement at St. Louis, Kansas City, Toledo and Peoria is likely to suffer an early diminution.

The live stock traffic here also showed a much larger volume than was anticipated, and the good average miscellaneous produce traffic will materially assist in keeping the earnings near to those for the closing week last year.

The following shows the amount of flour and grain delivered at Chicago by each of the Western railroads mentioned during the week ending Dec. 16, and the corresponding week in 1892:

	1893.		1892.	
	Flour.	Grain.	Flour.	Grain.
	Bbls.	Bush.	Bbls.	Bush.
C. & N. W.	20,227	1,179,000	41,202	696,000
Ill. Cent.	2,700	597,000	150	496,000
C., R. I. & P.	13,700	360,000	4,050	254,000
C., B. & Q.	4,717	1,150,000	13,044	820,000
C. & Alton	1,200	141,000	1,350	170,000
C. & E. Ill.	.....	102,000	150	86,000
C., M. & St. P.	23,225	693,000	38,800	506,000
Wabash	750	116,000	2,400	76,000
C. & G. W.	11,334	118,000	26,363	221,000
A., T. & S. Fe	.....	256,000	150	230,000
L., N. A. & C.	.....	3,000	.....	1,000
Totals	77,853	4,705,000	128,159	3,565,000

The past week showed a heavy shrinkage in flour, but it was compensated by an increase of nearly an equal number of tons of mixed produce, which pays decidedly more profitable rates for carrying. The inward coal tonnage was also large, and the out shipments of the same article increased 8,359 tons over the same week last year. The managers of the Western lines traversing the coal fields also report liberal to large shipments from the mines to interior consuming points. The Assistant General Manager of the Atchison, Topeka & Santa Fe said: "All the mines along our line west of the Missouri are being worked up to their capacity, and the demand for coal is so urgent that we are unable to supply sufficient cars to haul it." This statement is confirmed by parties just returned from there, who represent the consumers at nearly all points short of stock, and pressing the need for shipments.

Repairs and Equipments.—Despite recently printed statements regarding new contracts for track supplies and other equipment for leading Western roads, it cannot be learned that any actual business has been done. Personal interviews with the General Managers of leading lines elicited a unanimous statement that they were not in the market for material of any kind beyond ordinary requirements for repairs, etc., neither did they expect to place any orders until after the opening of the New Year.

The report that the Chicago, Burlington & Quincy system is largely increasing its working force is not confirmed by General Manager Merrill, who states that the increase included just 50 men distributed among the various car repair shops along the line, and that he saw no prospect of a further increase in the near future, as the work was not likely to exceed the ability of the present force to perform.

Iowa Railroads.—Managers of Iowa local roads who were here the past week stated to the officers of Chicago lines with which they connect that their requests made to the State Board of Railroad Commissioners for permission to advance local rates to a paying basis were received with more consideration than had been expected, and some of the Commissioners have already intimated that rates should be advanced to figures that will enable the lines to earn fair dividends over expenses and repairs.

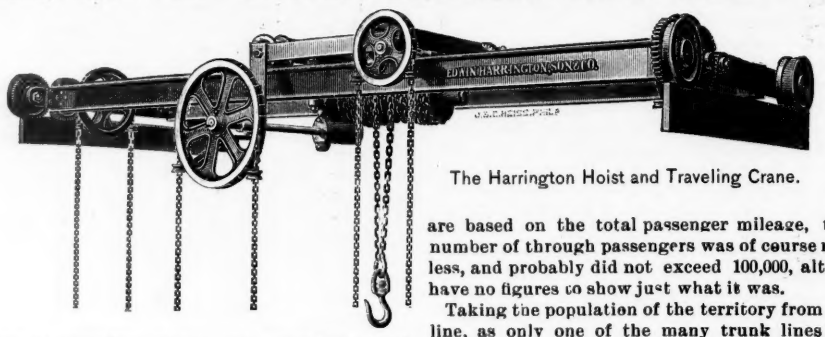
The number of carloads of grain and live stock received at Chicago by the Western railroads for the month of November and for the corresponding time last year compare as follows:

	1893.		1892.	
	Grain.	Live stock.	Grain.	Live stock.
A., T. & S. Fe	1,657	1,423	825	1,860
C., B. & Q.	2,967	6,054	4,689	5,414
C., R. I. & P.	1,601	2,041	1,688	2,591
C., M. & St. P.	3,762	3,506	2,984	3,888
C. & N. W.	3,905	4,038	3,046	4,357
C. & Alton	1,318	1,749	900	2,175
C. & E. Ill.	472	448	400	557
C. & Gt. W.	998	849	1,029	808
Ill. Cent.	3,170	1,588	3,012	1,915
Wabash	1,098	1,264	548	1,676
Wis. Cent.	26	250	17	413
Other roads	1,441	623	1,172	547
Total Cars	22,415	23,833	20,198	26,381

Chicago, Dec. 18, 1893.

A New Hoisting Device and Traveling Crane.

All foundry men know the necessity for a capable hoisting apparatus in their work, for lifting copes and molds. The ordinary chain and sprocket wheel, however carefully made, are liable to jar the load as each link leaves the sprocket wheel, and every jar is liable to crack and break down the mold. To obviate this difficulty the Edwin Harrington, Son & Company Corporation, of Philadelphia, has designed a new crane especially for foundry service, and for other service where delicate handling is required. It may be employed equally well in the handling light and heavy loads. The accompanying engraving shows its construction and operation.



The Harrington Hoist and Traveling Crane.

Instead of a sprocket wheel a drum is provided with right and left spiral grooves for the chain to wind in, insuring the position of the hook at the same point at all elevations. This drum is actuated by a worm mechanism clearly shown in the diagram. The movement is steady and sure, the chain winding and unwinding with the regularity of a rope on a windlass. A cope may be lifted and lowered with no danger of the sand sifting out or the molds breaking down. The gears of this hoist are worked by means of a long shaft extending out beyond the beam of the bridge so as to prevent the chain of the hoist from interfering with the load and it enables the operator to stand at a respectful distance from the work. The crane is operated by pinions and intermediate gears throughout, and the shaft of the crane is placed inside of the beam to save room. The shaft and axles of the gears are furnished throughout with roller bearings, thus producing an easy and free movement. This device will be greatly appreciated by foundry men who have had the unpleasant experiences of the ordinary chain or sprockets hoisting device.

World's Fair Passenger Business—Pennsylvania Lines.

The article which follows is the substance of a letter written to us by Mr. A. B. Starr, Superintendent Eastern Division Pennsylvania company, under date of Nov. 27, and the text in full of the report referred to in that letter. The probable passenger movement was the subject of much study by most of the railroads leading to Chicago, the preparations for it were considerable, and the actual results are still in doubt as to many roads; therefore it has appeared to us that this letter and report, giving the estimates and the results for one division of one of the principal lines, must be of great interest to every one who has given the matter intelligent attention. What follows is in Mr. Starr's words.

The estimate made in October, 1891, which is referred to in the statement, was based upon the only obtainable facts, viz., those relating to the business on the Pennsylvania Railroad at the time of the Centennial. The total paid attendance at the Centennial was 9,630,000, or a little over one-fifth of the entire population of the county at that time; average daily attendance, 60,566; average monthly attendance, 1,605,000. To this, for our purpose, it is hardly necessary to add the average number of exhibitors, which was 10,000 per day, as they represent but one trip each way.

From the Census of 1890 it is fair to assume that the population of the country increased from 1876 to 1893 nearly 50 per cent., and that the admissions to the Columbian Fair would, of course, be affected thereby, but probably not in the same ratio.

In my estimate as to the number of admissions to the Columbian Fair I was in error, owing principally to the fact that the exhibition was so much larger and more magnificent that the visitors were not satisfied with as few visits as at the Centennial, but when they were once there found it necessary to stay longer in order to satisfy their curiosity, or in very many cases made a second trip.

While the Pennsylvania Railroad reports for 1876 showed that it handled at the Centennial station 2,612,213 passengers, which covers incoming as well as outgoing business, or that about 1,300,000 persons were taken there by our trains, I assumed that the other lines leading to Philadelphia did not take more than half as many, or a total of 1,800,000.

As Philadelphia was within easy reach of a very much greater population than is Chicago, the number of one day's excursion visitors was unquestionably much larger than could be expected at Chicago; therefore, the total number of visitors to the Columbian Fair would not increase over those to the Centennial in a ratio corresponding to the increase in population.

The territory from which the main line of the Pennsylvania Railroad, between Pittsburgh and Philadelphia, drew its patronage in 1876 had a population of nearly 30,000,000, while the business, as shown by the annual report, showed an increase of 380,000 in average through passengers, or 190,000 in one direction. As these figures are based on the total passenger mileage, the actual number of through passengers was of course necessarily less, and probably did not exceed 100,000, although we have no figures to show just what it was.

Taking the population of the territory from which our line, as only one of the many trunk lines leading to Chicago, would naturally expect patronage, notwithstanding the general increase in population, I did not think, and so stated at that time, that our share of the through business in 1893 would be any larger than that handled by the main line of the P. R R. in 1876, or about 100,000. The figures for traffic over the P. R. R. in 1876, refer only to the increase over an average business, that being the point that was under consideration in order to determine what additional facilities were needed to handle the traffic.

REPORT.

Statement No. 1 includes only the number of trains which carried passengers and ran through from Pittsburgh to Chicago. No. 7, which carries mail and express only, and trains of empty passenger equipment are not considered in this. The figures showing the number of cars include the entire train baggage as well as passenger. The number of passengers carried refers to these through trains only; the local trains on the division, being practically not affected by the World's Fair traffic, are not taken into consideration. The term "through passengers" as used in these statements applies only to those making a continuous trip between Pittsburgh and Chicago, all others being classed under the head of "local passengers," although many of them were for Chicago from stations along the line.

The total of the westbound through business was 150,542, of which about 11.5 per cent. originated in or about Pittsburgh, the remainder being from points east thereof and coming to us from the P. R. R. lines. For the same period in 1892, the total of the through passenger business was 54,414, being an increase of 97,018, or 178.3 per cent.

While we have kept no exact record to show a comparison between the local business of those two years, yet the number of trains run, average number of cars used, and other facts, indicate that there was so little difference that we are justified in assuming that the above figures represent very nearly the aggregate increase in passenger traffic.

This being one of the points concerning which the operating officers were requested to give their views, during the latter part of 1891, I will refer to a letter written Oct. 20, 1891, to the General Superintendent, in which, after giving some figures in reference to the P. R. R. operations during 1876, I expressed my conviction that the increase in traffic would probably be something less than 100,000, which, while very near the actual figures over 1892, was somewhat under the true figures as my estimate was based on the business of 1890, those being the only figures then obtainable. During the six months of 1890 the through passenger traffic, as given from the records of the Accounting Department, was 184 per day, or 33,856, so that the actual increase of 1893, as compared with the figures on which my estimate was based, was 117,686.

Statement No. 2 shows the average number of cars and passengers, both through and local, per train; average total of passengers per car and train, as well as the maximum number in any one day during the six months.

Statement No. 3 shows the actual number of through trains on each schedule and for each month separately, together with the percentage of increase

STATEMENT NO. 1.

Through Trains, Cars and Passengers.

Month.	Westbound.					Eastbound.					Total.				
	Trains.	Cars.	Passengers.			Trains.	Cars.	Passengers.			Trains	Cars.	Passengers.		
			Thro.	Local.	Total.			Thro.	Local.	Total.			Thro.	Lo cal.	Total.
May....	204	1,509	14,467	23,719	38,186	229	1,634	7,961	25,767	33,728	433	3,123	22,428	49,486	71,914
June....	235	1,715	19,221	24,495	43,716	258	1,844	12,067	26,090	38,157	493	3,559	31,288	50,585	81,873
Jul....	203	1,691	16,759	26,133	42,892	226	1,749	13,547	31,448	44,995	429	3,350	30,3 6	57,581	87,887
Aug....	213	1,727	24,267	24,282	48,549	238	1,836	19,777	28,991	49,738	451	3,563	44,044	54, 73	98,3 7
Sept....	282	2,250	37,884	27,192	65,076	312	2,478	33,058	28,559	61,667	594	4,738	70,992	55,751	126,693
Oct....	338	2,597	38,944	27,610	66,554	404	3,017	41,934	29,929	71,863	742	5,614	80,878	57,539	138,417
Total.	1,475	11,400	151,542	153,431	304,973	1,667	12,547	128,344	171,784	300,128	3,142	23,947	279,886	325,215	605,101

STATEMENT NO. 2.

Averages and Maximums.

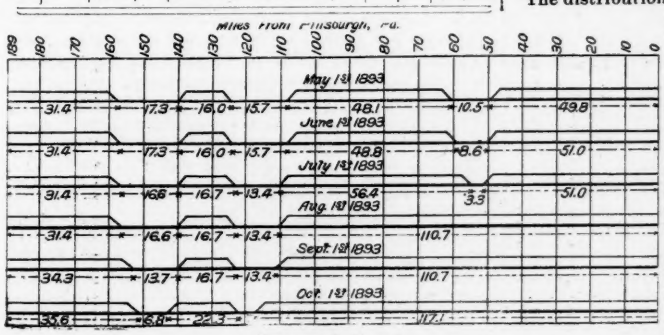
	May		June		July		Aug.		Sept.		Oct.		Six months		
	W	E	W	E	W	E	W	E	W	E	W	E	W	E	Total W-E
Av. cars per train	7.3	7.1	7.3	7.1	7 9	7.7	8.1	7.7	8.4	7.9	7 7	7.5	7 7	7.5	7.6
" through pass. per train	71	35	82	47	83	60	114	83	134	106	115	101	103	77	89
" local pass. per train	116	113	104	101	157	139	414	117	96	92	82	74	104	103	104
" total pass. per train	187	148	186	148	240	199	228	200	220	198	197	178	207	180	193
" total pass. per car	25.5	20.7	25.5	20.7	26.8	25 7	28.1	26.0	29 2	24.9	26.4	23.8	26 8	24.1	25.3
Max. through pass. 1 day	906	339	1,036	628	1,045	612	2,181	1,283	2,787	2,348	3,894	2,139	3,894	2,348	5,385
" local pass. 1 day	1,075	1,23	1,012	1,448	1,723	2,605	1,194	1,394	1,442	1,470	1,76	1,347	1,76	2,5 5	4,316
" total pass. 1 day	1,771	1,566	1,876	1,856	2,303	2,874	3,377	2,307	4,031	3,818	4,914	3,299	4,914	3,818	7, 78

STATEMENT NO. 3.

Trains.	May.		June.		July.		August.		September.		October.		Total.	
	No.	Per cent. of inc.	No.	Per cent. of inc.	No.	Per cent. of inc.	No.	Per cent. of inc.	No.	Per cent. of inc.	No.	Per cent. of inc.	No.	Per cent. of inc.
No. 9	37	2.8	34	....	37	2.8	39	11.4	52	52.7	63	75.	262	24.2
" 7	26	....	29	11.5	27	3.8	39	44.4	29	11.5	26	....	176	12.1
" 3	59	90.3	53	77	47	51.6	42	35.5	47	51.6	85	174 2	333	81.
" 25	54	74.2	82	173.3	59	90.3	72	132.3	119	283.9	123	296.8	509	176.9
" 5	31	....	31	16.6	31	....	33	6.5	35	12.9	52	67.7	217	17.9
" 1	27	....	27	....	27	3.8	27	....	25	....	28	3 7	161	1.9
Extras	..	....	1	....	4	....	4	....	6	....	10	....	25	....
Total	234	28 6	261	48.8	232	28.2	256	40.7	313	78.9	387	112.6	1,683	56.1
No. 4	31	....	30	....	31	....	32	3.2	39	30.	68	119.4	231	25.5
" 6	54	74 2	52	73.3	36	16.1	37	19.4	48	60.	49	58.1	276	50.
" 20	27	....	26	....	26	....	27	....	26	....	27	....	159	0.5
" 22	34	9 7	35	16.7	32	3.2	31	....	48	60.	60	93.5	240	30.4
" 2	33	6.5	30	....	31	....	31	....	47	56.7	62	100.	234	27.2
" 8	49	58.1	84	186	70	125.8	79	154.8	113	273.7	140	351.6	535	90.8
Extras	1	....	..	....	..	....	..	....	..	....	..	....	1	....
Total	229	25.8	257	46.	226	24.8	237	30.2	321	82.4	406	124 3	1,676	55.5
Grand total	463	27.2	518	47.2	458	26.5	493	35.6	634	83.6	793	118.5	3,359	55.8

STATEMENT NO. 4.

		Total number of trains.	Number of trains on time.	Number of trains leavo late and arrive on time.	Average time made up.	Number of trains making up time, but arriving late	Average time made up.	Lost time by accident.	Average time lost.	Lost time by connections.	Average time lost.	Lost time other causes.	Average time lost.
					M.	M.	M.	M.	M	M	M.	M.	M.
May.	W	234	108	48	15	73	15	21	2	7	9	17	14
	E	229	50	99	13	43	19	10	14	2	17	25	15
	Both	463	158	147	14	76	18	31	20	9	11	42	15
June.	W	261	105	56	15	37	22	30	53	6	12	27	12
	E	257	28	100	14	55	22	21	34	3	42	50	25
	Both.	518	133	155	14	92	22	51	35	9	27	77	22
July.	W	232	82	61	15	24	18	20	63	26	22	19	22
	E	226	24	100	13	38	18	23	47	1	80	40	27
	Both.	458	106	161	14	62	18	43	54	27	23	59	26
Aug.	W	256	93	53	15	43	17	17	44	17	18	33	10
	E	237	28	109	12	55	17	7	36	3	8	35	15
	Both.	493	121	162	13	98	17	24	42	20	16	68	13
Sept.	W	313	54	41	14	56	12	40	32	39	14	93	24
	E	321	20	67	20	110	22	28	70	16	26	80	26
	Both.	634	74	108	18	166	16	68	48	55	18	173	25
Oct.	W	387	51	25	13	48	17	89	65	34	27	142	9
	E	406	12	42	30	184	27	48	76	27	33	93	38
	Both.	793	63	67	23	227	25	137	68	61	30	238	18
Total, 6 months	W	1,683	493	284	15	236	16	217	49	129	19	384	18
	E	1,676	162	517	15	485	23	117	67	52	30	323	28
	Both.	3,359	655	801	15	721	19	334	55	181	23	657	23



Statement No. 5.

Amount of Second Track, First of each Month.

Note: Oct. 31, Orrville to Burton City opened for travel.

over the normal of one train on each schedule. In this statement, No. 7, which carries express and mail only, as well as the trains of empty passenger equipment, are included. The figures show an increase of 25 per cent. to 29 per cent. in the month of May, considerably greater in June, but drop back again in July; from then steadily increase to a maximum in October. The average for the six months shows an increase of 55.8 per cent. over the normal.

In my letter of Oct. 20, 1891, referred to above, the estimate as to the increase in passenger service was based on the number of trains then running, which was smaller by one schedule in each direction than 1892. The increase over 1891 is 83.1 per cent., or a little less than one-half my estimate. This is owing to the fact that the introduction of Class "X" engines enabled us to haul larger trains than was anticipated; and also that the number of coach excursions from the east, in which there was a high average number of passengers per train, was also greater than anticipated.

The greatest number of trains eastbound on any one day was on Sept. 30, when there were 16 through trains; westbound, on Oct. 21, 20 through trains. The maximum movement in any one day was also on Oct. 21, there being 35 trains—20 west and 15 east. The largest schedule run was on Oct. 11, on which day nine sections of train No. 25 were run, carrying 2,571 through passengers out of Pittsburgh, and probably adding somewhat to that number along the road. The heaviest run on any one schedule was No. 25 on Oct. 21, eight sections carrying 3,575 through passengers from Pittsburgh. The largest single train carrying the greatest number of passengers was a Pittsburgh excursion, leaving at 6:31 a. m., Aug. 16, arriving at Crestline at 1:35 p. m. It consisted of Class "X" engine 267, one baggage car and 18 coaches, carrying 912 passengers.

The distribution of the through passengers for Chicago between the westbound trains was as follows: No. 1, 8,379, or 5.5 per cent.; No 3, 16,820, or 11.1 per cent.; No. 5, 13,681, or 9.0 per cent; No. 9, 21,915, or 14.5 per cent; No. 25, 87,117, or 57.5 per cent.; extras, 3,630, or 2.4 per cent.

The trains under the head of "extras" were run over this division as sections of a local train. They could not, therefore, be properly classified under any of the through schedules.

Statement No. 4 shows the train movement under the headings of "On Time," which includes trains which were received and delivered on schedule time; train which were received late but arrived at the terminal on time and made up, but not sufficient, to reach the terminal on time; "trains losing time by accident," which includes delays caused by the failure of the engine, or any of the cars, and time lost by reason of other trains being disabled. In some cases the time lost on this account was considerable on account of the trains being obliged to make a detour, over some other line. Also in cases where a leading section was delayed by an accident, the time lost by the following trains is included in the figures given.

Under the heading of "time lost by connections" are included delays waiting for trains at intermediate points on the division but not at either Pittsburgh or Crestline. Under this heading are also shown the delays owing to stopping belated through trains for meals at either Alliance or Crestline, which, if they had been on time, would not have been done.

"Time lost by other causes" takes in all delays other than those given above and is very largely owing to the time lost in running one set of trains around another, as for instance, the sections of No. 2 around those of No. 3; sections of No. 22 around No. 20, and the sections of No. 5 around the excursion trains which were started from Pittsburgh on No. 25's schedule.

Another prolific cause of delay was the fact that the two heaviest schedules—No. 8, which in the month of October averaged nearly five trains per day, and of No. 25, which averaged four trains per day—by their schedule met on that portion of the division where the second track has not yet been completed.

Statement No. 5, showing the amount of second track on the division on the first day of each month, from May to November, will illustrate this point. The effect of a large increase in the number of trains is shown by a comparison of the figures given for May, when out of a total of 463 trains 381 made their schedule time or better, while but 82, or less than 18 per cent., lost any time, and only 42, or 9 per cent., were delayed by any cause which could have been foreseen and prevented; while in October, out of 793 trains, 357 made time or better; 436 lost time, and 238, or 30 per cent., were delayed from the various causes which arise from heavy traffic.

During the entire six months there was one accident to a passenger train, which, however, affected the engine only, causing a delay of about two hours in clearing the track and getting another engine; and two accidents to cars, consisting of broken axles under Pullman cars, which fortunately did not result seriously. The trains in both cases, were stopped without any part of the train off the track except the wheels attached to the broken axles. No passengers were killed or injured, nor any passenger train employes on this division during the entire six months.

Construction and Inspection of Locomotive Boilers to Prevent Explosions.

The following are extracts of a paper before the New York Railroad Club, Oct. 19, by Mr. D. L. Barnes. The 64 lantern slides which accompanied this paper are not here reproduced, but are given in full in the Proceedings of the Club.

It is now generally conceded that a boiler never explodes unless the steam pressure within is greater than the boiler can stand without rupture. This does not imply that the steam pressure is above that normally carried by the boiler, nor above that at which the safety valves blow off, but simply means that the steam pressure at the time of the explosion is too great for the boiler to stand. In nearly all cases of explosions, it has been found that the pressure did not exceed the *normal* pressure allowed by the inspector. Weakness of a steam boiler is always the result of one of three things, viz.: defects in construction or design, deterioration in service, or overheating. Probably not a single explosion has ever occurred at the *normal* pressure for any other reason. Those explosions that have resulted from *excess* pressure have generally been caused by defective safety-valves and steam gages; however, there is one other cause for excess pressure, but more properly shock, not confined to safety valves and steam gages. It is the sudden opening of a very large valve when the water in the boiler has nearly all become heated to the temperature of the steam. Several cases of this kind are on record, but they are very rare, and generally speaking there are no apertures in boilers that can be opened quickly enough to cause an explosion. The bursting of a manhole cover or a dome cap might do this, but manholes and dome caps are a part of the boiler proper, and defects in them are really defects in the boiler as a whole. Unless a boiler is weak, and has very little margin of safety at the working pressure, it will not be exploded by the sudden opening of any of the valves that are generally used in connection with boilers.

The action which leads to the explosion of a boiler, when the pressure is suddenly released, is the same as that which tears and fractures boilers when there is an explosion; it is the shock of the water, which is thrown against the sheets by the sudden expansion of the steam within the water itself.

In the examples given of the destructive effect of expanding water, it will be noticed that the sheets are torn and ruptured as if struck by some body moving at a high velocity. The simple escape of a confined gas or steam would not produce such results as are here shown. The explosive force of any highly heated liquid, such as water, gasoline, petroleum, ammonia or even mercury, when the pressure is suddenly removed is now well understood. With water the action is about as follows:

When water is heated to a high temperature, say 380 deg. Fahrenheit, which corresponds to about 180 lbs. boiler pressure, it has heat enough in it to make a large amount of steam at a low pressure; therefore, if the pressure be quickly dropped by the sudden opening of a large aperture there will be a vast volume of steam generated instantly; in fact, the water practically bursts into steam when the pressure is instantly removed. The sudden generation of steam within the water itself throws the water against the sheets with tremendous force, and in all boiler explosions where there is the usual quantity of water in the boiler the effect of the

explosion is many times greater than when the boiler contains steam only at the time of the explosion.

The first rupture of a steam boiler shell is always caused by the giving away of some part under steam pressure, but as soon as an opening is made the rapid escape of the steam causes a sudden lowering of the pressure, and a part of the heated water bursts into steam and forces the remaining water against the sheets, producing a tremendous shock, as shown by the illustrations. If a boiler contained only steam or air no such results as these would follow an explosion.

If the pressure on a cubic foot of heated water be reduced from 180 to 100 lbs. per square inch, the original cubic foot will instantly expand to fill 12 cu. ft. If the pressure be reduced to the atmospheric pressure, as in the case of a rupture of a large sheet, the original cubic foot will expand instantly to fill 240 cu. ft. This shows how important is the presence of water in the boiler at the time of the explosion. Without water, explosions are not accompanied by extensive destruction of other parts of the boiler than that one which fails at first. Also a comparatively slow reduction of pressure by the opening of a limited aperture does not generally result in an explosion. . . .

As an illustration take the case of a Belpaire boiler. The crown-sheet became overheated and the stays pulled through the sheet, there being no nuts or large heads beneath the crown-sheet. The material in the crown-sheet was excellent. The sheet did not fracture. The escape of water through the holes formerly occupied by the stays was so slow that the pressure was reduced gradually. In general small ruptures of a boiler below the water line are not as dangerous as those above the water line, for the reason that the pressure is reduced less rapidly by the escape of water than by the escape of steam, when both flow through the same size of aperture. . . .

This rupture emphasizes the argument made for the omission of heads and nuts from crown screw-stays below the crown-sheets. It has been quite conclusively shown by actual cases that where the material of the crown sheet is good and there are no nuts on the lower end of the stays, it is nearly impossible to have an explosion from an overheated crown-sheet, mainly for the reason that the stays pull through the sheet a few at a time, the sheet is not ruptured, and there is a gradual reduction of pressure in the boiler. This has been the experience of the railroad from which the illustrations were obtained. In several cases no explosion followed an overheated crown-sheet, and the firemen became careless, and that road has now returned to the use of heads and nuts on crown stays in order that the explosion may be severe enough to emphasize the need of watching the water level. The road now has fewer hot crown-sheets, but very much more disastrous results. Here followed examples showing the sudden expansion of heated water.

The following table gives a summary of such boiler explosions as have been brought to public notice in this country during the last 14 years. It will be seen that there were more explosions in 1892 than in any one of the 13 years preceding. A majority of locomotive boiler explosions are the result of low water. Defective inspection and neglect of repairs of stay-bolts cause nearly all of the remainder. 9.5 per cent. of all explosions are of locomotives. If the number of persons killed and injured in each locomotive boiler explosion averages the same as for other boilers, then the average per year for locomotive explosions is 25 persons killed and 35 injured. As the majority of all locomotive explosions are due to low water, for which the engine crew is responsible, and as the engine crews are generally the persons injured, it would appear that the majority of persons who are killed by locomotive boiler explosions lose their lives by their own negligence. This is not true of other accidents on railroads.

TABLE OF EXPLOSIONS OF BOILERS SINCE 1878.

Year.	Saw mills and wood working manufactures.	Locomotives.	Marine.	Portable boilers.	Mines, etc.	Paper and flour mills, bleacheries, etc.	Rolling mills and iron works.	Distilleries, breweries, etc.	Textile manufactures.	Miscellaneous.	Total.	People killed.	People injured.	Locomotive boiler explosions. Per cent. of total.
1879	41	16	13	9	4	10	..	8	8	13	132	208	214	12.1
1880	47	18	15	13	8	19	13	10	2	22	170	259	555	10.5
1881	38	12	14	18	5	8	16	8	4	36	159	251	313	7.5
1882	50	14	24	9	10	15	18	4	..	28	172	271	369	8.1
1883	74	17	15	15	11	13	6	5	4	24	184	263	412	9.3
1884	53	15	15	18	7	12	5	8	1	15	152	254	261	9.8
1885	33	10	16	16	20	13	10	18	1	18	155	220	288	6.5
1886	45	22	14	16	17	8	15	16	3	29	185	254	314	11.9
1887	73	14	14	20	13	12	15	9	1	27	198	264	388	7.1
1888	69	23	20	39	12	13	13	12	6	18	240	331	505	9.4
1889	56	15	13	21	9	8	14	8	4	32	180	304	433	8.3
1890	75	25	16	16	19	8	13	3	1	50	226	244	351	11.0
1891	68	22	17	35	23	15	16	9	6	46	226	263	371	8.6
1892	79	33	11	24	13	12	24	2	..	71	269	298	442	12.3
Total											2,685	3,684	5,185	....
Average per year											192	263	370	9.5

Inspection and Defects.—One of the difficulties under which inspectors labor is a lack of definite instructions. But few, if any, of the rules for inspection give a clue to what is wanted from an examination, and only in rare cases are any definite instructions given about how to conduct the details of an inspection. Generally, the inspectors are left to their own judgment, and being men with a limited knowledge of boiler design, the result of their inspection is correspondingly limited. By good inspection and proper construction, all danger of boiler explosions can be avoided. After boilers are built, everything depends upon intelligent and well recorded inspection. Some of the points that need especial attention are the following:

One of the most fertile sources of errors in boiler construction is the bracing. Defective welds at the point shown and bad rivets with thin heads give this result; the stay breaks suddenly without warning. . . . Here follow examples of bad staying.

Bracing in locomotive boilers requires more attention than any other part, particularly the braces having pin ends or crowfeet, as distinguished from screw-stays. In crown-bar boilers, such stays are very numerous and expensive to put in properly. With wagon-top crownbar boilers the bracing is complex and extensive, and after the stays are in it is practically impossible to examine them, and a defective one, if found, cannot be removed without first removing many others. Only small men and boys can get at many of these stays, and as the tendency is to use boys for this work, it is seldom that an inspector sees all of the stays, as they are put in at the boiler shop. Formerly, the crown-stays were shrunk in, that is, they were heated and allowed to shrink into position. This practice was followed when the pressures were low, the boilers were small, and the stays few in number. Now they are put in cold, and frequently too slack to be of any real use until the crown-sheet has deflected more than it is safe to permit. Stays should always be put in tight, and to accomplish this they must be either shrunk in or put in with a right and left hand thread, as done by one locomotive builder in this country.

There is much difference in accessibility of the stays in different types of boilers. The most complex type is the crown-bar boiler. To put in this large number of stays, so that they will draw properly, is impossible. Proper inspection is also impossible, and this is what has led to the use of boilers of the Belpaire and the radical-stay type. In all of these screw-stay boilers, each individual vertical stay is acccesible for inspection from the outside, and, when they are made hollow or have "tell-tale" holes, the inspection is constant and practically automatic, as breakages are made apparent immediately by the escape of steam The main advantage of screw-stay boilers is, that the tension on the stays, when the boiler is under pressure, is somewhere near uniform; and if in a screw-stay boiler the longitudinal stays, which are few in number, be provided with a right and left-hand take-up, it is possible to adjust all of the stays in the boiler so that they will draw evenly. With a crown-bar boiler, even with a right and left-hand "take-up," it is practically impossible to make the stays draw evenly or to inspect thoroughly. . . . The only safe method of determining whether there are sufficient stays in a boiler is to make an accurate calculation on the plan followed by all of the best boiler builders.

Defective rivets are as common as defective stays. The most common defect is the offset rivet. They are the result of badly matched holes that are not reamed out by a fluted reamer before the rivet is driven. In locomotive boiler work a fluted reamer should always be used, and a drift pin should never be permitted.

Thin rivet heads are not common in parts of boilers where they can be observed, but inspectors have to watch constantly to prevent them where they cannot easily be seen. In a badly organized shop, where the inspection is poor, this sort of head is frequently found.

Machine-driven rivets are generally much preferred to hand-driven or "button-set" rivets, but one-sided heads are more common with machine-driven rivets than with hand driven ones.

Next to pin-stays and crowfeet stays, screw-stay bolts are the most important details for an inspector to watch. Screw-stays are made by contract, the holes in the boiler are tapped by contract, and the bolts are put in and riveted up for a fixed price per bolt, and the inspection of stays by locomotive builders themselves is very limited. All this goes to show, not the evil of contract work, which of itself is necessary in order to bring the cost within reasonable limit, but to illustrate the importance of attention on the part of the railroad inspector to the material, the threading, tapping, insertion and riveting up of screw stays. A loose screw-stay never breaks off at the sheet. The first stay to break, other things being equal, is the one that has required most force to screw it into place. Tight-fitting stays always cause complaint from the workmen who put them in. It is fortunate that this is the case, otherwise there would be more broken stays. Frequently screw-stays are put in tight with a sharp thread in the sheet and on the bolt. The stay-bolt is of the softest iron that can be purchased in the market. The sheet is a comparatively hard steel. When the soft bolt is screwed tightly into the hard sheet, having a sharp thread, the action is like that of a "jam-die" which forces a thread on a piece of wire without cutting. The action of such a die is to indent and ruin the surface material. The action is not unlike that of a cutting chisel used by smiths to fracture large bars. A comparatively small nick around a large bar will cause it to break quickly with a small amount of bending or by a comparatively small shock. This is the reason why stay-bolt iron that will stand repeated bendings through a wide angle before it is put into place will fail quickly with small bending given it in a locomotive boiler by the expansion of the sheets. After a recent boiler explosion, caused by neglect of stay-bolts, it was found that the destruction of the iron in the bolts by bending at the point where indented by the sheet was so great that the bolts could be knocked off the sheets with one blow of a light hammer. Before they were put in the boiler, some of the samples of the same material stood several bendings backward and forward through an angle of 180 deg., the bolt being held in a vise and bent with a piece of gas-pipe.

Stay-bolts should be put in so that the threads in the sheet do not indent the bolt. This is done by removing the top of the threads in the sheet. Preferably, the bottoms of the threads of the stay-bolts should be round and not sharp. Reliance for tightness may be placed wholly on the tops of the threads of the bolts. The fit for tightness should be on the top, and not on the bottom of the thread of the bolt. . . .

When the stay is large enough, the sheet bends more than the bolt during expansion, and in this way the bolt stands longer. In locomotive boiler work the thickness of the sheets is out of proportion to the stays. If the stays were larger in diameter there would be fewer broken ones. Probably the introduction of 1¼-in. screw-stays in the way described in the foregoing would remove almost completely the prevailing troubles with screw-stays. . . .

A solid screw stay-bolt without a tell-tale hole should never be used in a locomotive boiler. . . .

Domes should always be provided with heavy strengthening rings at base. . . . For shell laps the butt joint should be used for locomotive work, and the inside welt should be wider, and should have two additional rows of rivets, one on each side, to attach it to the shell. It is very essential that the inside welt should be riveted to the shell at some point beyond the calking edge, which is on the outside or narrower welt. None of the other forms of joints pull in a straight line, or in a true circle, and they should never be used for locomotive work on longitudinal seams, except for small sizes of boilers. Wide welts should always be rolled to the curvature of the shell before they are riveted on. . . .

A small radius should never be used for the root of a flange for a boiler head that is put in like a locomotive boiler back-head, where the flange is in tension, as distinguished from flanges in compression, like those on front tube sheets.

In boiler inspection, "grooving" and "pitting" are the defects most difficult to discover. Pitting will occur frequently without apparent cause or reason, and, while it is more frequent at the bottom of the shell than elsewhere, yet it is liable to occur almost anywhere below the water line. . . . Here followed examples of grooving, pitting and cracking.

Almost invariably, dangerous cracks will make themselves evident by leakages, hence the importance of following up each case of leakage to the origin. . . .

Laminations are not dangerous, but if bulges resulting from laminations are not removed the boiler may finally become dangerous. Laminations are expensive to repair, and generally require the removal of an entire sheet. They arise from bubbles of gas in the molten steel, which leave holes in the ingot when cooled. These holes are rolled out into laminations in the sheet. . . .

The effect of mud and scale on a boiler-sheet that is exposed to the fire is best shown by examples from stationary boiler practice. Exaggerated cases are not as common in the fireboxes of locomotives because the boilers are better cared for. Mud acts as a non-conductor of heat to the water, and the sheet becomes overheated and plastic, and stretches.

Some of the interesting remarks and conclusions about inspection and defects, that have been brought out by recent correspondence with *master mechanics* regarding boiler explosions and inspections, are as follows:

"As Horace Greeley once said about the resumption of specie payment, 'The proper way to resume is to resume,' so with inspection, the proper way to inspect is to inspect."

"Boilers should be studied for their weak places."

"How can a new master mechanic on an old road learn quickest if the boilers are safe to run?"

"The danger from broken staybolts is greater than from all other bad conditions."

"If one staybolt breaks, the others near it are strained and they break. Finally explosion occurs, when the pressure applied to one bolt will pull it through the sheet. In one case, after an explosion, it was found that a leaking staybolt that had been repeatedly calked was the only good bolt in its vicinity, and was itself pulling through the sheet, hence the leak."

"Staybolts break most at the points of greatest expansion, viz., at top corners of the firebox; but the largest percentage of breakages occurs on the back head and throat-sheet; there are so few bolts at these points that a small number of failures gives a large percentage."

"Badly corroded staybolts cannotbe detected by hammering, therefore occasionally one should be taken out to see the general condition."

"Too often the rules issued to inspectors would read, if condonsed: 'Look sharp, be wise and examine well, but don't ask how to inspect.'"

"Our practice here is to blow the boiler up with steam and sound her every thirty days."

"It is difficult to get inspectors to do work faithfully, and only comparatively boys can get at the principal places to be examined."

"It is no excuse that engines are busy and cannot be spared for examination; the prevention of explosion comes before anything else in locomotive service."

"The top rows of staybolts should be renewed every three or four years whether broken or not."

"There is but little difference between the 'very best' and the 'good' staybolt iron. It all cracks after a while, but 'ordinary' iron is very inferior material for staybolts."

"Hollow or tell-tale staybolts will save time and prevent explosions, but it is sometimes inconvenient to have the stays leaking through the tell-tale hole."

"The keynote is, careful inspection."

"The life of locomotive boilers is from 18 to 20 years, and I divide this period into three periods of five years each. After 15 years, boilers need special supervision."

"I am an inspector, but my instructions are so blind that I don't know where or when my duty is done or when or for what I am responsible."

"We are putting in staybolts by force of habit, and, like others, probably we are going on in a groove It is not possible but that something better can be done than the old ⅞-in solid bolt."

"A general inspection by one man for a whole road does not give good results, the local Master Mechanic should be held responsible."

"We keep run of the different locomotive builders, and now know their weak points and what to look for; if cracks appear in one of a lot of boilers, they will be found in others in the same lot."

"Since we commenced washing out boilers with hot water, our fireboxes give no trouble and we have less broken stays. In busy times, when we rush the engines, we wash any way that we can and we get back to the same old trouble."

"Staybolt tests ought to be made by screwing stays into sample sheets and then bending."

"Boilers should always be measured over all when being tested under pressure to determine the change in form."

"A leak points to danger, and should never be stopped until its source is found. It is bad practice to stop a leak by putting bran in a boiler."

Classification of Boilers.—For the purpose of inspection, locomotive boilers may be divided into three classes, as follows:

First Class.

The boilers of this class are those having the following requisites:

(*a*) All longitudinal seams with butt laps and with short welt outside and long welt inside, so that the calking edges are backed up and not allowed to move when pressure is put on or taken off the boiler.

(*b*) With stayscrews in crown.

(*c*) All parts of waist truly cylindrical within 3/16 of an inch as shown by measurements taken when the boiler is cold at three points, including the points where the butt-joint is located.

(*d*) All parts that are flat or oval and not intended to be cylindrical, stayed with screw-stays, or some form of staying that can be reached quickly for inspection and which draws uniformly on the flat surface. All braces without end play when boiler is cold.

NOTE.—To fall within this class, it is necessary that the staying should have been thoroughly inspected when the boiler was built or when in such condition that a close examination could be made of each part by itself, and this inspection must be on record in detail in the Master Mechanic's office.

(*e*) The outside dimension of any part taken when the boiler is cold, with full pressure on, and when cold, with pressure off, must not vary more than 1/16 of an inch at any point. Particularly does this apply to the vertical and horizontal over-all measurements at the point where the dome is attached, and at the middle of the sloping top of wagon-top boilers and at the center of the length of the firebox, crosswise at the bottom of the ring and crosswise at the center line of the boiler near the top of the crown-sheet. Measurements of this kind must have been actually taken and be on record in the Master Mechanic's office.

(*f*) Dome holes provided with stiffening rings not less than 5/16x3¾-in. section, and double riveted to shell. Two rows of rivets passing through flange of dome. All dome braces free from end play when boiler is cold.

(*g*) Each individual sheet must have been purchased under modern specifications, with test strips attached to the sheet, and the analysis of the test strips, both chemical and physical, must be on record in the Master Mechanic's office.

(*h*) Thickness of all sheets in accordance with best common practice and in proportion to the working pressure, and with nothing unusual or experimental in shape or thickness.

(*i*) The general design one that has been proved by service and without any radical feature in any part, and with sufficient bracing to give a bursting pressure by calculation equal to at least five times the working pressure.

(*j*) Staybolts in sides of firebox not less than 1⅛ in. in diameter. All screwstays in crown 1¼ in. in diameter or more. All

screwstays put in so that the fit for tightness is made on top of the thread of the screwstay and not on top of the thread of the sheet. All screwthreads on stays round at bottom. All screwstays hollow or with tell-tale holes drilled from outside to a point half an inch beyond the inner face of sheet. Material of screwstays of best quality of rolled iron, the tests of same being on record in the Master Mechanic's office.

(*k*) Taking the mud-ring as a measuring point, no screw-stay in firebox less in length between sheets than 8 per cent. of its distance from the mud-ring.

(*l*) Back head with lining plate of equal thickness with the head, and extending from flange at top to the third row of screwstays of firebox and with heavy T or angle iron braces riveted through both plates. All back-head braces without end play when boiler is cold, and of a size to give a calculated ultimate strength seven times the working load, so as to allow for bad welds.

(*m*) Boilers having all of the foregoing requirements and of a design, construction and material, and in a condition that leads to confidence in the mind of the Master Mechanic having them in charge. Any doubt about the safety of any part of a locomotive boiler prevents its being entered in this class.

(*n*) Boilers built under inspection and according to well recognized rules for the construction of boilers, especially including the reaming of holes with a fluted reamer when they do not match or when the tapers of the holes do not both incline toward the face of the joint between the sheets.

(*o*) No sign of grooving or cracking in any sheet, no cracks between any two rivets, no pitting of sheets in furrows, and no circular or oval pit more than ⅛ of an inch deep.

Second Class.

Boilers of this class have the following characteristics:

(*a*) Lap-joints on any horizontal seam.

(*b*) With crown-bars.

(*c*) Circular part of shell not truly cylindrical within ¼ in. when cold.

(*d*) Defecting staying, lack of staying, too small stays to give a calculated strength of seven times the working load, or staying inaccessible for quick and intelligent examination. Loose stays, or stays having end play when boiler is cold.

(*e*) Movement of more than ⅛ in. at any overall measuring point when pressure is on or off. Lack of record in the matter of movement prevents the boiler from entering the firs class.

(*f*) Dome holes without stiffening rings. Dome braces with end play.

(*g*) No complete tests or record af sheets.

(*h*) Sheets not so thin as to cause apprehension or danger, but too thin according to modern practice.

(*i*) General design not having been proved by service, or one having radical features, or less calculated bursting pressure than five times the working pressure.

(*j*) Screw staybolts less than 1⅛ in. in diameter. Screw stays that have sharp threads at bottom, and on which the sheet is made tight at bottom of thread of stay. Solid screw-stays without tell-tale holes.

(*k*) Screwstays less in length than 6 per cent. of their distance from the mud ring.

(*l*) Back head without lining. Back head-braces loose or with end play when boiler is cold. Back head-stays and braces too small or too few to give a calculated strength of seven times the working pressure.

(*m*) Failure to meet the requirements for the first class, or in a condition or of a design that causes the Master Mechanic to be suspicious or lack confidence. The utmost confidence must be had in all details before a boiler should be entered in the first class.

(*n*) Boilers built without thorough inspection. Rivet holes stretched with drift-pins or suspicious workmanship at any point.

(*o*) To enter the second class there must be no sign of grooving or cracking in any sheet. No cracks between any two rivets. No pitting in furrows and no circular on oval pits more than $\frac{3}{16}$ in. deep.

Third Class.

The boilers of this class are those failing to meet the requirements of the first class and having any of the following defects:

(*a*) Tendency to leak at laps; repeated leaking at same place after calking.

(*b*) Weak crown-bars, so that crown deflects as much as ⅛ in. under full working pressure; scant staying from crown to shell of dome.

(*c*) Shell measures more than ½ in. out of circular form at any part of cylindrical shell when cold.

(*d*) Staying defective in any of the following points: Defective looking welds; too small or too few rivets in crow feet; too small pins between crow feet and stays; less than two braces for each crown-bar between crown-bars and shell or dome, on crown-bar boilers; without heavy angle or T-irons nearly covering the back head and without liner for back head; defective or small stays between shell and back tube sheet at bottom of shell; any stay having more than ⅛ in. end play when boiler is cold; staying generally inaccessible for quick and intelligent examination by inspector with lamp and long-handled hammer when inside of boiler above the tubes, or any practically permanent obstruction, so that inspector cannot positively certify about the condition of the important stays.

(*e*) Movement of ¼ in. at any point when full pressure is put on and taken off

(*f*) Dome single riveted to boiler through flange at base of dome.

(*g*) Sheets suspicious or of very uncertain grade; tendency of sheets to crack in boilers built in the same lot, at the same time, by the same builder. Tests of sheets and records show the physical qualities of material below that considered good in common practice.

(*h*) Design having radical or questionable experimental thickness or shape of sheet; belonging to a class of boilers requiring many and frequent repairs to keep from leaking at joints; boilers over ten years old; boilers that have been in serious head-end collisions where shell rivets have been sheared; sheets less than 75 per cent. of thickness that would be given at the present time to new boilers for 160-lb. pressure.

NOTE.—This is a necessary limitation, as a defective steam gage or an error in setting the safety valve might result in allowing a weak boiler to run for a considerable period with the same pressure as used on good boilers on the same division of the road.

(*i*) Design bad, or having radical or questionable experimental features, or having a calculated bursting pressure less than four times the full working pressure, allowance being made in the calculations for 3 per cent. annual deterioration in sheets for all points that are not liable to more rapid deterioration. Calculation should be based on best obtainable knowledge of the real condition of the material.

(*j*) Breakage of adjacent staybolts in considerable numbers quickly following the breakage of one bolt.

(*k*) Screw-stays placed generally over 4½-in. centers, or staybolts having practically the same length at top as at bottom of firebox.

(*l*) Back head without adequate T or angle-irons and without liners, or showing a tendency to bulge out as the boiler is continued in service.

(*m*) Belonging to a lot of boilers of which one has exploded because of weakness of material or design.

(*n*) Inspection having showed defective workmanship or material when built. Defective or split flanges on back head or top sheet at dome or throat sheet. Less than three vertical T-irons, or less than six vertical angle irons of heavy section for braces on flat sides of sloping wagon top, or if these braces do not reach 6 in. above and below the commencement of the flat part of slope and are not well riveted at both top and bottom to the shell sheet. Ill-fitted sheets that open up at the joints in one place when another is calked tight.

(*o*) Grooving in any part, especially near a lap. Pits or furrows more than 6 in. long and $\frac{1}{16}$ in. deep in any part. Oval or circular pits more than $\frac{1}{16}$ in. deep if occurring near together. Cracks in sheets or braces between two rivet holes. A crack in any sheet tending to spread and without "strengthening" patch, as distinguished from a patch put to prevent leakage.

Inspection of First Class.—These rules are applicable only to the average condition of service; hence special cases or conditions of unusual severity, such as very bad water or unusual forcing of the fires, require shorter tervals between inspections.

(1) Never remove the jacket for any purpose without examining the shell for incipient leaks and defects.

(2) Once every six months remove dome-cap, throttle and dry pipe, and examine all stays that are above tube and crown sheets by tapping and shaking them, to see if loose or broken. Take up slack in stays when it is more than $\frac{1}{32}$ in., and record accurately the number of the slack stay so found, its position and the amount of slack taken out, on the blank provided for that purpose. Examine all joints of shell for grooving and pitting, particularly at the water line.

At least once each year or 18 months examine the bottom of the shell on the inside for grooving or pitting. Where the feed water is bad, this examination will be done quite often enough if it is accomplished when the tubes are removed for cleaning. Once every year or months examine with a looking glass, a lamp (incandescent electric is best) and a hard-steel scraper, all joints of sheets and all parts of sheets where there is a change of form, as from cylindrical to flat. At these points look for grooving and pitting. Never remove the throttle and dome-cap between general examinations without making a partial examination of the braces, stays and joints that can be readily reached.

(3) Once each month remove jacket from firebox and clean out the holes in the screw stay bolts.

(4) Never allow a leak to continue even for one day, nor allow it to be calked up without first learning the real cause of the leak and making a formal report of its amount and its true origin on the form provided for that purpose. In this way all possible explosions due to grooving and cracking of sheets can be avoided. If the leak is under the jacket, the jacket should be removed at once and a very careful examination made, and the origin of the leak determined before it is stopped In nearly all cases of boiler explosions on record, where the explosion was not due to defective safety-valve or overheating, the explosion has cast a shadow before it as a warning, in the shape of a leak. Hence the necessity of following up a leak to its origin, and not calking and patching until the real condition of the sheets and braces at the point of leakage is known. A leak generally indicates a movement of the sheets.

It is not neccessary to remove other stay-bolts around a broken one if the bolts are put in as called for in the requirements for a boiler of the first class.

(5) Two safety plugs should be placed in each crown-sheet, one front and one back. These plugs should be removed and refilled once each month.

(6) Complete records of the inspection should be kept in full form; this can be done with less expense by providing inspectors with blank forms having diagrams of the boilers to be inspected, and giving the location of each individual stay, brace, plate and bolt, all numbered for reference. The printing for this form of report costs far less than the time of an inspector to write out a description of the part found defective. Records with diagrams of boilers are much more accessible for reference than written descriptions.

NOTE.—So long as a boiler meets the requirements of the first class this inspection is all that is neccessary to absolutely prevent explosions, if the safety-valves are in working order and the water is not allowed to get too low. Even withlow water, if two safety plugs be used one at the front and one at the back of the crown sheet, and these plugs are refilled each month, there is no real danger of an explosion except from too high pressure, and as the pressure would have to rise to nearly 400 lbs. per square inch before there would be much danger of an explosion, it is evident that there is, in fact, but little danger of an explosion as a result of the safety-valves sticking. Even if the safety-valves should be locked down, the leakage of the boiler, which would take place long before there was danger of bursting, would give sufficient warning to the boiler attendant.

All stay-bolt defects are made apparent in boilers of the first class by leakage, and a hammer test is unnecessary, hence when stay-bolts are properly selected and put in there is absolutely no danger of any considerable number giving out at one time.

Grooving will not occur to any considerable extent unless there is appreciable movement of the sheets when the pressure varies. No considerable movement of the sheets is allowable for boilers of the first class. Pitting is dependent upon the water and the uniformity of the material in the sheets, and has not been satisfactorily explained, but is not dangerous except in aggravated cases, and will not increase so much within the time limits of the inspection provided for in boilers of the first class as to put a boiler in a dangerous condition.

A hydraulic or steam test somewhat above the normal pressure is of no value to determine the safety of a boiler. No boiler is safe to run that will not stand three or four times the normal pressure without rupture. In any case, a steady test pressure does not produce as much stress in a boiler as is produced by the sudden opening of a large safety-valve when the pressure is at the working point. The sudden opening of a pop-valve gives a rapid reduction of pressure, which makes a suddenly-applied load on the boiler due to the quick formation of steam within the water, thus causing the water to rise quickly and straining the boiler somewhat more than the normal pressure or the commonly-used test pressure. The only value of a hydraulic or high-pressure steam test is to give a better chance to measure the change of form of the boiler when the pressure is put on and taken off, and also it shows where there is a tendency to leak. If the boiler is cold, a cold-water test to the ordinary test pressure can do no harm; it is not necessary to warm the water. But if the boiler is hot, then cold water should never be put into it for any purpose. The principal value of a high-pressure steam test is that in duplicates the exact working conditions and will show where the boiler is liable to leak in actual service. It is is not safe to test a boiler to a point that will give any adequate idea of its real strength, for such a test is liable to stretch some of the staying and open the joints; the excess of strength in a boiler is provided only for emergencies, and the pressure that a boiler can stand should only be determined by calculation; any attempt to do so by actual test will generally injure the boiler. When a boiler is regularly in service, it is known whether it leaks or not, and if it does not leak there is no necessity of applying a pressure test when an inspection is made, unless some repairs or changes have been done that might cause leakage. The principal use of a pressure test after inspection is to avoid delays resulting from leaking at the joints that have been opened during inspection.

Inspection of Second Class.—This inspection has been compiled from a mass of correspondence with railroad men since Aug. 1, 1893, and gives the prevailing practice at the present time, as it is given in the printed instructions of railroad companies in this country.

(1) All new locomotive boilers must be tested with hot water at pressure of 25 lbs. above working pressure, and be calked tight under this pressure, before going into service.

(2) This test must be made once a year for the first two years, and thereafter every six months.

(3) The gage used in pressure-testing must be corrected by comparison with the test-gage in toolroom.

(4) When boilers are being tested, the foreman of the machine shop, having under his charge the repairs of locomotives, must attend personally, remaining outside, while an assistant examines the firebox from the inside.

(5) A record of all tests must be made by inspector, giving dates and everything worthy of mention; this must be signed by the persons assisting.

(6) Special examinations of the staybolts of locomotives in service must be made once every week.

(7) An inspector especially trained for the service must tap each staybolt from the firebox side, and judge, from the sound, which of them are broken.

(8) This test to be made in the following manner: All the water to be let out, and a steam pressure of from 30 to 50 lbs. placed on the boiler, which will produce sufficient strain upon the sheets to cause a separation of the bolts if any are broken. The bolts will then be tapped from the inside of the firebox by a competent mechanic, while his assistant holds on to the outside, when he can judge from the sound which bolts, if any, are broken. Braces must be examined after each test.

(9) The inspector must keep an accurate record of the location of each imperfect stay-bolt, and report the same to the master mechanic, who will see personally that the stay-bolts are removed, and allow no locomotives to remain continually in service with one or more stay-bolts broken.

(10) In replacing a broken stay-bolt, the next stay-bolt in front and back in the same horizontal row, and the ones directly above and below the broken bolt, must also be replaced.

(11) No locomotive must be allowed to remain in service when there are one or more stay bolts broken in the top row.

(12) The tell-tale holes in the ends of all screw stays must be cleaned out thoroughly when engines are in the shop for repairs.

(13) The dates of all tests of boilers and examinations of stay-bolts must be given by road foremen of engines on their monthly reports.

(14) At each roundhouse point there must be an inspector whose business it is at the end of each trip to examine boilers, flues, fireboxes, etc., and who must make it a point, at least once a week, to make a special examination of each firebox.

(15) Dome caps must be removed every three months, and a careful examination made of the interior of the boiler, so far as practicable, without removing the tubes.

(16) In cases where the purity of the water renders unnecessary the removal of tubes for cleaning purpores during general repairs, tubes must be specially removed for the purpose of internal inspection of the boiler at least once in every four years.

(17) A careful memorandum of the principal defects found in different builds and classes of locomotive boilers is to be kept, and these points are to be carefully examined in going over the boilers of similar engines; such points are also to be very closely watched on engines in service, and any evidence of weakness followed up. Experience has shown that cracks in one boiler of a class indicate that other boilers of the same class are very apt to be defective.

(18) Never allow engines to be blown out hot, but reduce temperature by forcing in hot water while the engine is being blown out until temperature is neutralized, thus preventing the baking of silt and scale on tubes and plates.

(19) A printed card giving maximum allowable steam pressure is to be placed in a frame with a glass cover, and screwed up in cab in front of the engineer. The engineer is required to report, on the engine-house repair register, the exact pressure at which the safety-valves open. The foreman has a list of allowable pressures for all boilers in service, and compares the reports of the engineers with this list. Road foremen of engines are required to examine the safety-valves and steam gages, to see if they agree with each other and with the allowable pressure posted in cab.

(20) When boilers are being tested, the foreman of the machine shop and the foreman boiler-maker must attend personally, while the competent mechanic examines the boiler. The full-test pressure must be maintained until his examination is completed. At roundhouses the roundhouse foreman will take the place of machine shop foreman, with two competent men to assist him.

(21) A record of all tests, giving the dates of same, and the condition of all parts opposite their respective headings, also any other points worthy of mention must be signed by the foreman and the assistants conducting the examination.

(22) Each master mechanic must keep a record of boilers tested and inspected, giving the age of the boiler, the date tested, date inspected, the name of the inspector, and giving general remarks on the condition of the boilers. All records and reports are to be made upon printed blanks, having a diagram of the boiler tested, and showing the location of each stay-bolt, stay, brace, plate, etc. The diagram on the form must accord exactly with design of the boiler, or the inspector must make notations thereon which will explain accurately any differences between the design and location of stays represented by the diagram and the actual construction of the boiler.

(23) All of these rules apply to all boilers, whether in the shop on the main lines, or at outlying points.

(24) All boilers, whether stationary or locomotive, shall have two fusible plugs located at the danger line for low water. In locomotive boilers one shall be placed at front and one at back of firebox, in the crown-sheet. All fusible plugs to be removed and refilled once each month, and a record made of the date of such removal and refilling on the record book in the master mechanic's office.

Inspection of Third Class.—This class of boilers is difficult to examine, and it requires the constant and continual attention of expert inspectors. Constant vigilance is the only safeguard to security with such boilers. Rather than to use them, it is better either to reconstruct the bracing or sell them for scrap. A reduction of the working pressure will make them but little if any safer. It is a variation of pressure, if only of 50 lbs., which finally destroys boilers of this class. Deterioration arises from the movement of the sheets. There are too many boilers of this class in use and they continue in use, not because of the apparent loss if they were thrown away, but solely for the reason that their true condition is not known to those who operate them.

It is quite clear from these directions for inspection of the three classes of boilers that it is cheaper for a railroad company to buy a first-class boiler and to use only first class material. The additional cost to make a boiler of the first-class, over and above the cost for a boiler of the second class is too small a percentage to permit the cost to affect a decision about the most desirable boiler to purchsse. If railroad companies do not have good boilers it is not because this country does not furnish the material, workmen and tools to make them, for the best on earth are here. To get a first-class boiler there must be a trained inspector sent to the boiler works and the master mechanic must be at liberty to demand what he wants, and the builders must be paid a small extra price, perhaps $50 for each boiler, for superior workmanship and materials. It is generally true that master mechanics are allowed too little money for boiler construction, inspection and repairs, and are given fewer locomotives to use than are needed to allow sufficient relays for boiler inspection.

It is to be feared that boiler building is not taken seriously enough, and is carried on in altogether a too haphazard manner. It was all well enough in the days when locomotives were small and had but 15 lbs. pressure, to use some of the crude bracing which has been illustrated here. But now boilers carry more than ten times that pressure, and are necessarily more strained because of the larger dimensions, and only the best and most scientific design and construction should be permitted. So long as steam is used to haul trains, internally fired boilers with flat surfaces will be necessary. The future locomotive power may be electricity, and if so master mechanics will not have steam boiler inspection to contend with. The serious way in which locomotive boiler design and construction, and more particularly inspection, should be considered is emphatically brought to mind by the illustrations shown by the lantern slides, which show the results, that may be expected from locomotive boiler explosions.

[The discussion will be given next week.]

Service Record of the "Greater Britain"

On the occasion of the recent trip of the London & North Western locomotive "Queen Empress," from Chicago to New York, the representative of the company issued an advertising folder for the benefit of persons who visited the train at the cities along the route where it was stopped for exhibition, and this folder contains the following particulars of one week's running between London and Carlisle by the locomotive "Greater Britain," which is a counterpart of the

"Queen Empress." The week's work was laid out to test the engine, and two crews were put on. The statistics are as follows:

	Tons.	Cwt.
Weight of engine and tender in working order	77	2
Average weight of train, including passengers, baggage and mails	160	8
Ditto, including engine and tender	237	10
Time-table time, deducting stops	76 h. 7 m.	
Deduct time made up by engine.....	0 50	
Actual running time.....	75 h. 17 m.	
Total distance travelled attached to trains	3,588 miles.	
" " " light.....	24 "	
	3.612 miles	
Average speed..... 3,588 miles / 75 hrs. 17 min.	47.66 miles per hour	
Total weight of coal consumed, excluding lighting up	47 tons 17 cwts.	
Actual consumption of coal per mile, excluding lighting up.....	29.87 lbs.	
Ditto, including 1.2 lbs for lighting up.....	31.07 lbs.	
Ton miles, excluding engine and tender.....	575,557	
Ton miles, including engine and tender.....	852,224	
Consumption of coal per mile per ton of train, including passegers, baggage and mails, but excluding engine and tender, at 29.87 lbs. per mile..	2.979 oz.	
Consumption of coal per mile per ton of train, including passengers, baggage and mails, and including engine and tender, at 29 87 lbs. per mile...	2.012 oz.	

TIME TABLE AND MILEAGE FOR SIX CONSECUTIVE DAYS.

April, 1893.	Mileage.	Schedule including stops.	Schedule deducting stops.
		h. m	h. m.
1st day, 17th (12.41 a. m.) to 18th (12.34 a. m.)	598	13.38	12.38
2d day, 18th (12 41 a. m.) to 19th (12.34 a. m.)	598	13.38	12.38
3d day, 19th (12.41 a. m.) to 19th (5.34 p. m.)	457	10.26	9.36
4th day, 20th (12.05 a. m.) to 21st (12.34 a. m.)	739	17.14	1 .59
5th day, 21st (12.41 a. m.) to 22d (12.34 a. m.)	598	13 38	12.38
6th day, 22d (12.41 a. m.) to 23d (12.34 a. m.)	598	13.38	12.38
Total.....	3,588	82.12	76.07

The folder also gives some description of the engine from which we extract the following:

The engine has two high-pressure cylinders 15 in. in diameter × 24-in. stroke, and 1 low-pressure cylinder 30 in. in diameter × 24-in. stroke. The engine is carried on four pairs of wheels; the leading and trailing pairs being 4 ft. 1⅛ in. diameter, and the driving wheels 7 ft. 1 in. diameter. Both pairs of driving wheels being placed in front of the firebox necessitates the adoption of a long boiler, the barrel of which is 18 ft. 6 in. long, made out of ⅝-in. steel plates, having a mean diameter of 4 ft. 3 in., the firebox casing being 6 ft. 10 in. long. An intermediate combustion chamber is placed in the barrel of the boiler, between the firebox and smokebox tube plates, so as to divide the tubes into two lengths. Access is obtained to the chamber by an opening at the bottom, to which is attached a hopper for getting rid of the ashes which may accumulate in the chamber. To the bottom of this hopper is fixed a valve which is air-tight and weighted in such a manner that in its normal position it will be closed, but it is also connected to the footplate with a rod, so that it can be opened when necessary to let out the ashes. There are 156 tubes 2⅛ in. outside diam.; the length of those between the firebox tube-plate and the combustion chamber tube-plate being 5 ft. 10 in. long, and those extending from the combustion chamber forward to the smokebox tube-plate are 10 ft. 1 in. long. The total heating surface of the tubes is 1,346 sq. ft.; the combustion chamber 39.1 sq. ft. and firebox 120.6 sq. ft., making a total of 1,505.7 sq. ft. The grate area is 20 5 sq. ft. The weight of the engine in working order is 52 tons 2 cwts., of which 15½ tons is carried by each pair of driving wheels. The tender, which is fitted with the water "pick-up" apparatus, weighs 25 tons in working order, and has a tank capacity of 1,870 gallons, and carries 4 tons of coal. The total wheel base of the engine is 23 ft. 8 in., and of engine and tender 43 ft. 11¼ in., and total length of engine and tender over buffers is 54 ft. The height from rail level to center of boiler is 7 ft. 10½ in. Steam pressure 175 lbs. per sq. in.

The Louisville & Jeffersonville Bridge Accident.

On the 15th inst. another great disaster overtook the Louisville & Jeffersonville Bridge, a span of 546½ ft. having fallen into the river, carrying with it many of the workmen. In order that the facts might be fairly presented to the world, we telegraphed to Mr. Deans, the Chief Engineer, for his story of the accident, which we publish practically in full. The drawings to which he refers were not received in time for reproduction, but engravings of the falsework and traveler will be shown next week.

LOUISVILLE, Ky., Dec. 18, 1893.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Fortunately it is rarely necessary for an engineer to be called upon to report upon such a serious accident as has been met with in the construction of the Louisville & Jefferson Bridge. The Phœnixville Bridge Company, the contractors for the superstructure of this work, desire to place before the engineering public through your paper a full and detailed description of their plans for the permanent superstructure and their plans for temporary falsework and traveler, and they also desire to place before the engineers a complete description of the facts regarding the causes which led to the accident as far as they have been able to locate them after a complete investigation. This they desire to do, not alone for their own protection, but to give the engineers throughout the United States the benefit of their sad experience here. To this end we have mailed to you a general plan of the entire bridge, a full detailed plan of one of the 553 ft. spans, a detailed plan of the falsework and a detailed plan of the traveler, and to these drawings the following report will refer.

(1) The river portion of the bridge in which we are particularly interested consists, beginning with the Louisville side, of two 340-ft. single track through spans, three 553-ft. single track through spans, and one 210-ft. span.

(2) At the time of the accident on Dec. 15, 1893, the two 340-ft. spans were complete in every particular and falsework removed, having been finished about Oct. 15. One 553-ft. span had all material in place and falsework removed, with ties and rails in position. The second 553-ft. span had all of the falsework in place and seven double panels of the trusses, with upper laterals and transverse bracing, in place. In the third 553 ft. span, the falsework was being put in place from each end—three bents in place on the Louisville side and eight bents in place on the Jeffersonville side. The last span, being the 210-ft. span on the Jeffersonville side, had been entirely completed for a year and a half.

(3) *Falsework.*—The sizes and details of this falsework are shown clearly by the plans. The piling was new, first-class selected yellow Southern pine, and was driven with a 3,200-lb. hammer; the penetration in the bottom of the river varying from 10 to 16 ft. In no case was a less number of piles driven per bent than shown on the plan, and in a number of instances where it was thought a perfect bearing or perfect work had not been secured an additional pile was put in. Additional X bracing was also put in at a number of points, both longitudinally and transversely, and also considerable lateral bracing immediately at the tops of the piles. [A description follows this letter.—EDITOR.] This extra material was put in in no special and systematic manner, but was simply an extra precaution at any point where the Superintendent in charge of the work thought that it was needed to make it doubly secure, and as protection against high water and ice. The falsework material was all new Southern yellow pine, and had not been used before this work. It must be borne in mind, however, that one of the 553-ft spans had been erected successfully on falsework in exact accordance with plan and in water at least 10 ft. deeper than was any time found during the raising of the second 553-ft. span. The traveler was of new Southern yellow pine timber, and was especially designed to offer as little resistance as possible to the wind, iron rods being used instead of timbers for the longitudinal X bracing. The traveler, as those engineers familiar with erection are aware, is not necessarily a stable structure under wind pressure, and is provided at each corner with guys and also at each bent with transverse guys to be used during the windstorms. And these were all in place and ready for such an emergency when the accident occurred. The traveler was rigged with four hoisting engines in the plane of the lower sills, two hoisting engines on each side.

(4) The conditions immediately preceding the first wreck were as follows: The ironwork of the trusses of the second 553-ft. span had been erected from the fixed or Louisville end up to a point within two double panels of the Jeffersonville end on the night of Dec. 14, 1893, and the traveler was left at this point guyed securely for the night and with the last cord sections connected, but still attached to the lines. The men at the time of quitting work on the last panel on Thursday evening had started to drive the lower down-stream cord pin through the truss and lower cord. The next morning when they came to continue their work they found this joint exactly in the same condition as when they left it the night before; absolutely no settlement had occurred, and the pin was driven home without delay. The traveler was then unguyed and unlashed from the metal work and moved ahead to start raising the next double panel. It must be borne in mind that the falsework at this point had no load upon it with the exception of the traveler, and the weather was blustery at the time traveler was moved, and as the falsework immediately under it showed signs of slight swaying and movement up stream it was thought to be best, as a matter of precaution, to pull the traveler back to its first position in the morning and send men down to put on additional bracing at the leve of the pile caps to hold the falsework at that point more securely. A sketch was immediately made by Superintendent Milliken of the manner in which this was to be done, and Mr. McKee, the General Foreman in charge of the work, started down and with a gang of men was soon on his way with the steamboat and barges with extra bracing to attend to this work, having left instructions with his traveler foreman to move traveler back so that piling could be relieved and this bracing put on.

The blustery condition of the weather increased as the day passed and it came in squalls, and while the traveler was being unguyed and blocking being taken out to move back, a sudden squall struck it at an angle, and, from the reports secured, twisted it to the right and probably threw it off of the traveler rails, although this cannot be positively stated. At least, it is evident that it was lifted on the windward side, and practically all of the weight was thrown on one corner. This crushed down the bent and piling immediately under the support, and without a moment's warning, not giving the men time to run 50 feet, it went down. The traveler evidently did not blow over, but simply settled down with the false work up stream, as the up stream engines were in their proper position with even the tools in the tool chest undisturbed. This seems to bear out the supposition that immediately after the squall passed and had done its work the traveler regained its position and settled down with the wrecked falsework. Of course, the conditions and partially unfinished span were such, that immediately on the giving away of this bent the whole structure necessarily came down, as there was a tendency, of course, to push toward the Jeffersonville end. . . .

A number of the men who were working immediately adjoining the Jeffersonville pier had time and presence of mind to get on the top of the masonry, some 17 in all, and these men, with a coolness which is simply remarkable, immediately took measures, even in the midst of this terrible wreck, to fasten the three bents and false work immediately adjoing the pier and in the third span. This falsework consisted of three full bents, thoroughly braced, and on top a falsework traveler with engines and boiler and rigging with it. They took five lashings of 1½-in. line around these bents and falsework and around the pier, and had this work done in about 15 minutes. About 5 minutes after this another terrible gust of wind struck the pier, forcing the men to lie down, and twisted the falsework traveler to the right in the same manner as the main falsework was twisted, and blew the whole of the falsework and traveler into the river. This was the second accident, and all thought it was the last.

The men in the steamboat, who were to put on the extra bracing, immediately turned all their energy to rescuing those who had gone down with the span. Those killed were taken out as well as a number of injured and a number who were not hurt, the total number going down being about 52. This work of rescuing the men was continued all afternoon and into the dark of the evening, when at about 8:20, without a moment's warning, a sound was heard like the roaring of cannon. The men on the wreck were blown down on their faces the piledriver near the Jeffersonville pier was nearly upset, and in the midst of all this confusion the first 553-ft. span was blown into the river. The force of the winds at the level of the water was terrific, lasted but a moment, but in the air some 125 ft. above and on a level with the trusses, it must have been something terrible.

The span had been erected some three weeks, all of the material was in place, the floor system had been riveted complete, the floor beams being riveted between the posts and the stringers between the floor beams, and all the upper lateral bracing portals, transverse bracing, upper cord joints and intermediate post joints were thoroughly bolted up and riveting was progressing. At least four-fifths of all the holes were filled with bolts. This we know positively to be the case, as it was the subject of special instructions to the foreman about ten days or two weeks before the accident happened, and a special gang of men was sent over to put in this full number of bolts after the regular and ordinary number of bolts had been put in as the span was being erected. In addition to this the ties were temporarily in place, being spaced about 3 ft. centers with rails in position and spiked down, and over this span we had run all of the heavy iron and material for the second 553. The span, including the floor ties and rails, weighed at least 2,000,000 lbs.

Our method of erection was as follows, and will be seen by those familiar with work of this character to be the usual method used: The trusses including the upper lateral bracing and the transverse bracing are first put in place, and the span is then swung off without any floor or lower laterals in position, and as fast as the falsework is removed this floor and lower laterals are put in place. All contractors appreciate that in the interim between the swinging of the trusses and the placing of this floor and lower laterals there is a period of anxiety should a severe storm be met with. We had several such here, some so severe that the men could not walk, but saw no signs which gave us any anxiety, and it is unexplainable to us how a span in the condition in which this first 553 was on Dec. 15, 1893, could have been blown down by anything but the most extraordinary force. From the location of the wreck in the river it is evident that the span did not collapse and was not blown directly down, but lifted, as the bottom cord, including the floor, is all on the boctom of the river with the upper ends of the end posts, and the upper cords above them, and showing above the water. The piers also give no evidence of the spans dragging over them; in fact, the roller frame with pedestal above it is intact on the Jeffersonville end, and the fixed pedestal with the anchor bolt nuts stripped off is on the Louisville. The direction of the wind was the same as in the case of the disaster to the falsework, being at an angle and striking the fixed end first, and this end was forced at least 35 ft. up the river before it fell. It would look reasonable to suppose that the roller end would be forced off first, but such was not the case. The greatest force of the wind existed at the fixed end of the structure. Had the span collapsed it would, of course, have dropped immediately between the piers and dragged off of the ma

sonry; but this is not found to be the case. Had the transverse bracing yielded it would have forced the upper cord over, and it would have been found in the bottom of the river; but this is also not found to be the condition of affairs, and it must evidently have been lifted directly off of its supports and blown up the river.

Weather.—We are securing from the Government Signal Service Observer here a full detailed statement of the condition of the weather at the time and immediately preceding the wreck. There was evidently cyclonic indications, as was generally stated in the papers. The weather was hot and sultry, and we understand that the time of the blowing down of the span, between 5 and 8 p. m., is the time when cyclones are to be expected in this vicinity when the conditions are favorable. We have not had time to collect data regarding the course of the storm at other points. We have simply information that a short time after the accident here a cyclone struck Muncie, Ind., and immediately preceding the wreck here there was a cyclone or at least high winds in southern Kentucky The regular report of the Signal Service Observer at Louisville only shows a velocity of 36 miles per hour, but any engineer can readily prove to himself that such a pressure could not dislodge a span of this magnitude, even though it were carelessly constructed and erected. We are continuing our investigations and shall give engineers the benefit of anything we learn on the subject.

(6) The lives lost, we fear, will foot up a total of 21; 7 bodies have been recovered and 13 men missing. This shows the suddenness with which the disaster occurred, as the men could een in a place of safety if they had only received two minutes' notice. The individual examples of heroism among the men were numerous, and the coolness with which they proceeded to assist their unfortunate associates in the midst of all the terrors of the wreck could not but excite admiration, and could only be shown by such experienced and hardy men as the bridge erectors are well known to be.

After the falsework for the second 553 ft. was in position and we started to raise the iron, we experienced a rise in the river of about 10 ft., and at the time of the wreck the river had fallen until the water was pressing down about 6 ft. above low water.

J. STERLING DEANS, *Chief Engineer.*

The drawings show the falseworks resting upon five rows of 9-in. piles, the two outside ones double and the two intermediate rows double at every other bent, the others and the center row being single. These piles were 45 to 65 ft. long and for about 30 ft. were without bracing, being under water. These were capped with 12×12 and 6×14 in. sills, upon which were placed the legs 8×12 and 10×12, with four rows of longitudinal horizontal braces 8×12 and 4×12 in. The vertical distance between these braces was 18 ft. Every third trestle bent had 2 sets of diagonal braces 3×12 in. crisscrossed both ways. The total height of this falsework above the bottom of river was about 125 ft., and 72 ft. above the caps of the piles.

The trestle bents were about 30 ft. 4 in. apart, and were braced transversely by 12 × 12 caps, 3 × 12 intermediate horizontal, and by two sets 3 × 12 or 3 × 10 diagonal braces running both ways.

The traveler runs upon two tracks, one each side of the iron superstructure. It was 103 ft. high, and gave a clearway of 32 wide × 92 high, or a total height from low water to the top of traveler of 200 ft. The traveler was constructed in the usual manner, with a ratio of height to least width of about 2 to 1.

Premiums for Speed and Power.

Attention is attracted to the subject of premiums and penalties paid to or exacted from builders by the Government for speeds greater or less than the contract requirements. Secretary of the Navy Herbert has caused a statement to be compiled giving interesting information on this subject. Premiums are paid or penalties exacted on account of both speed and horse power developed. The amount of premium so far won for excesses in speed, including that of the Columbia, is $1,040,000. The sums won by the several contractors are: The Cramps, $650,000; Columbia Iron Works, $150,000; Union Iron Works, $100,000; Bath Iron Works, $95,000, and Moor, Sons & Co., $45,000. Should the Olympia sustain her preliminary record of 22 knots she will give her builders, the Union Iron Works, a further sum of $400,000, the largest single premium won by any firm of builders.

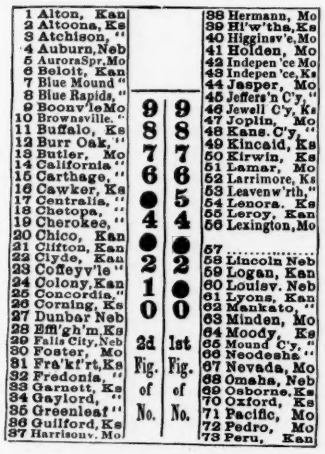
The Castine has made the greatest excess of speed. Her score is 2.62 knots over contract stipulation. Following in their order are the Machias, with a record of 2.46 knots; the Bancroft, 2.37; Marblehead,* 1.44; Detroit, 1.71; New York, 1; Philadelphia, .68; and San Francisco, .52. Rewards for speed excesses were greater for the larger and more important vessels. The Castine and Machias were small gunboats of 1,050 tons displacement, and their builders received only $50,000 and $45,000, respectively. The amounts won by the other ships were: Columbia, $350,000; New York, $200,000; Marblehead,* $125,000; Detroit, $150,000; San Francisco $100,000; Philadelphia, $100,000; Bancroft, $45,000. The Vesuvius exceeded the requirements for speed by 1.64 knots, but the contract provided for no premiums. In no case has any one of the new ships failed to develop the required speed. No penalties therefore have been exacted.

The requirements of 12 of the new ships call for specific horse power without providing for any particular speed Under this head premiums amounting to $187,000 hav been paid and penalties in the sum of $67,092 exacted The Cramps received $183,000 of the premiums and the N. F. Palmer Company $4,062. The penalties have been paid by the Union Iron Works and the Columbia Iron Works. The names of the vessels which have exceeded horse-power requirements, with the amounts of excess, are: The Boston, 280 excess H. P.; Chicago, 84; Yorktown 398.25; Baltimore, 1,064.42; Newark, 368 57; Concord, 4.53 and Bennington, 36.09. The money value of such premiums was: For the Yorktown, $39,825; the Baltimore, $106,442; the Newark, $36,857; the Concord, $453, and the Bennington, $3,609. The vessels which fell below contract requirements in this respect, together with the amounts of deficiencies and the penalties forfeited, were: The Dolphin, 60 H. P. below, no penalty; Atianta, 155, no penalty; Charleston, 338.84, $33,884; Petrel, 4.85, $485, and Monterey, 327.23, $32,723.

* Builders have petitioned for a new trial.

The Boss Coupon Ticket.

Mr. Fred M. Shattuc, of Cincinnati, issues a circular describing a new form of combination ticket which he has designed and on which he has applied for a patent. The essential feature in which the ticket differs from other forms of this general kind is in printing a larger number of destinations on each ticket and thus making it possible to sell to a greater number of stations with a single form. The circular claims that the number of stations shown on the form (73) is 55 more than has ever been used on any other ticket. A saving of 75 per cent. in forms and 35 per cent. in stock is thereby figured out. On one road Mr. Shattuc found a stock of tickets for 55 routes, which cost $7,300 to print and which he offered to replace with his forms for $1,300. For these routes he would use 60 forms instead of 140.



F. M. Shattuc's Ticket.

We print below a fac simile, full size, of the back of one coupon of the sample published. To avoid the inconvenience and possible chance of error in punching destinations on such a small scale the large figures in the center of the coupon are provided. Thus, in the sample shown, the destination is Station No. 24 (Colony, Kan.), as indicated by punch marks above and below the figures 2 and 4. In the next coupon the relative positions of the first figure of the number and the second figure are reversed so that, after folding the coupons, the whole of a ticket can be punched at one stroke. It is claimed that with the right kind of a stamp, properly used, there is no need of obliterating a destination by the date stamp.

TECHNICAL.

Rowell-Potter Safety Stop on the Alley Elevated, Chicago.

The Chicago & South Side road has closed a contract with the Rowell Potter Safety Stop Company to equip the line, its stations and to equip some of its switches with a system of automatic visual signals and safety stops somewhat similar to that designed by the Rowell-Potter company for the Intramural road at Jackson Park (see *Railroad Gazette*, Oct. 6, 1893). Thirty-seven stations and the more important switches, such as the relay switch in the Sixty-first street yards, the crossover switch at Congress street and others, are to be provided with signals and safety stops.

The method to be adopted will be as follows: A visual signal and track instrument will be placed about 330 ft. before each station so that a train approaching the station, when the signal is in the clear position, automatically throws the signal to the danger position and elevates the "incline" of the track instrument. If a following train attempts to pass this signal before the signal is cleared by the preceding train passing over the clearing instrument, placed about 630 ft. beyond the stations, the airbrakes are automatically applied on the following train.

On the Intramural road, the signals were released electrically, and the system was connected throughout the entire length of the road, as described in the *Railroad Gazette*. On the Alley the signals will be released mechanically and the signals at each station will be entirely independent of those at any other station. The plans for this work are now being prepared.

The Final Trial of the Cruiser New York.

The trial trip of the New York which was necessary before her acceptance by the Government took place Dec. 12 and 14. The object of this trip was to show that the vessel was free from serious defects after having been several months in commission. The test consisted of a 48-hour sea-going voyage in which her machinery and equipment were all successively put to test. The first test was to couple the two forward engines to her crank shaft, which required about 20 minutes and a 100-mile run in a moderately heavy sea. Under a steam pressure of 135 lbs. her patent log recorded 16.9 knots an hour. She pitched considerably, but the roll was not at any time more than 10 degrees on either side. The screw made about 103 revolutions a minute with a very poor quality of coal. The coal supplied for this trial cost $2.60, while that used by the contractors in their speed trial was hand-picked and cost $7.50. The bottom is undoubtedly foul, for she has not been in dry dock for six months.

At her speed trial she made 21.07 knots under forced draft. Experiments in turning resulted in showing that the ship could make a complete circle of about three times her length in diameter, or 375 yards in six minutes, and in about 275 yards and 7½ minutes time, when the starboard screw was going ahead and the port one backing. The test for stopping showed that the ship could come to a halt from full speed in about 750 yards in 9 minutes .07 seconds; by reversing her engines she was brought to a standstill in 1 minute 46 seconds and before she had run her own length. With both propellers making 102 revolutions the speed of the vessel at this time was at 15.93 knots an hour. The members of the Board decline to state the result of the trials in advance of their official report.

Wire Fences.

One of the objections to a wire fence in which smooth wire is used, with no connections between the wires except at the posts, is that cattle easily push their heads between wires and then break down the wires, so they can walk through. One of the objections to barb-wire fences is that the barbs tear the flesh of the animals and this, especially in the case of horses, is very objectionable. If the smooth wire is used, the wires in the fence should be held so as not to be easily separated. Barkley & House, railroad fence builders, have been using for several months plain wire, each wire being connected with the adjacent wires by what may be termed a double link loop. Each link is in the shape of a V. Two links are interlocked at the closed end of each, the opposite end of one is twisted about one wire of the fence and that of the other link about the adjacent wire. With this arrangement, when the wires are pressed together, the links telescope, but it is impossible to spread the wires beyond the normal distance without breaking the links. The links are generally placed 6 ft. apart and are put on after the wire is stetched.

The Busk Tunnel.

Trains began running through the great tunnel on Dec. 13. Storm doors have been constructed at the openings to prevent the drifting of snow when the blizzards rage over the continental divide.

The First Wire Rope Made in the United States.

In a letter to the *Bulletin* of the American Iron and Steel Association, Mr. W. A. Roebling says that the first wire rope made in this country was made by his father, the late John A. Roebling, at the village of Saxonburg, Pa., in 1840. In this rope the wire was parallel-laid, and served on the outside with annealed wire. It went to pieces as soon as the serving wore out. The next rope was made for one of the inclined planes of the old Portage Railroad across the Allegheny Mountains. The length of this rope was about 1,500 ft., and its diameter 1¼ in. It was constructed on correct principles, substantially in the same way that wire rope is made at the present day. It lasted a long time and gave good satisfaction. Its success was the means of introducing wire ropes on the remaining nine planes of the Portage road. Before wire ropes could be used on these planes it was necessary to rebuild the old inclined plane machinery, which was only suitable for hemp ropes. The new machinery was designed and constructed by Mr. Roebling. After this wire rope was adopted for the planes of the Morris Canal, and then by the Delaware and Hudson Canal Company and others. In 1848 Mr. Roebling moved his plant from Saxonburg to Trenton, as most of his business was in the East.

Photographing a Projectile.

In a lecture to military officers at Berlin, Germany, Professor Fritch exhibited photographs of a projectile and the air waves caused by it while in transit. The atmospheric disturbances shown upon the photograph from a legible record of the velocity with which the projectile traveled. The professor is able to make these photographs by the aid of electricity. A very interesting fact connected with the undertaking is that the invention was made by a boy named Vernon, a resident of Edinburgh, Scotland. *The Engineer* of Sept. 15, 1893, had some photographs of a 12-in. gun at the instant of discharge, but in these the projectile cannot be seen nor are there any phenomena apparent from which the velocity of the projectile could be determined.

RAILROAD GAZETTE

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EDITORIAL ANNOUNCEMENTS

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting, and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

The conferees of the United States Senate and House have agreed upon amendments to the New York & New Jersey Bridge bill granting the charter, with the privilege of putting a pier in the river, but giving the same right to the North River Bridge Co., which proposes to cross the river at about the latitude of Twenty-first or Twenty-second street, New York City. This is subject, of course, to the approval of the War Department. The two bridge companies are therefore placed on the same basis, as regards this privilege, and the North River Bridge may be made with a shorter span than is now contemplated and a cheaper one, if the War Department permits a pier in the river so low down, and if the projectors of the bridge wish to use the shorter span. On the other hand, the North River Bridge has no State charters, while the New York & New Jersey Bridge has charters from both the states of New York and New Jersey. A suit is now pending before the United States Supreme Court which will settle the question whether or not the North River Bridge Co. may, under its Congressional charter, condemn property for its own uses. This, it will be seen at once, is an exceedingly important and far-reaching question, and a favorable decision, would, we suppose, establish the principle that Congress may invade the rights of private property for the benefit of private persons, in any of the states. It seems extremely unlikely that the Supreme Court will sustain a principle so foreign to the spirit of the constitution and the traditions of the nation; but it is useless to speculate as to the probable decision. If it goes against the company it will then, we should suppose, have to seek state charters. If the decision is in favor of the company the most natural outcome would be a consolidation of the two bridge schemes.

There have been a number of costly and serious accidents to bridges in process of construction, within a few years, but none of such magnitude as that which has just taken place at the Louisville and Jeffersonville Bridge. Here, as will be seen from the Chief Engineer's story on another page, one span completely erected and almost entirely connected up fell, for no obvious reason, about 10 hours after the fall of the traveler, falseworks and partially erected span adjoining it. This unfortunate bridge has had a singular history of vicissitudes. On Jan. 10, 1890, a number of men were drowned in a caisson. The caisson tilted, and the men in attempting to escape wedged the door of the air lock, thus allowing the air to escape. In May of the same year a caisson turned bottom up. We shall not attempt now to estimate the cause of the present much more serious disaster. It is said by some of the daily papers that the company was rushing the work to completion, as it considered the falsework unsafe. This, of course, is nonsense. Any contractor would have been particularly anxious to get the falsework out from under any bridge in the Ohio River at this time of year. Nor is the accident without precedent. In August, 1888, the Phœnix Bridge Company lost the falseworks and much erected material of a 550 ft. span with traveler, engines and boilers at the Cincinnati and Covington Bridge. In May, 1890, the Edge Moor Bridge Works lost the falseworks and considerable erected material of a 525 ft. span at Wheeling. But the worst accident of this class that has happened before was the loss of a span of the bridge over the Licking River at Newport, Ky., June 15, 1892, in which 30 men lost their lives. All three of these works were being carried out by men of great experience and recognized ability, and it would be unbecoming to judge hastily of the similar accident which has now happened. So far as can now be judged the traveler in going off its track wrecked one bent and the others fell in on it; which was the way in which the false works of the Cincinnati and Covington Bridge over the Licking fell, except that in the latter case the first wreck was caused by the fall of an upper chord member. The disaster at the Licking bridge was attributed to insufficient longitudinal bracing, and it may be decided that the fundamental cause of the present accident was weakness in the falseworks.

The Lehigh Valley Railroad won the fight with the strikers. The Brotherhood leaders claim that if all the points conceded by President Wilbur in his letter to the state arbitrators (reported in the *Railroad Gazette* of Dec. 8) had been conceded before the trouble began there would have been no strike; but we cannot see that Mr. Wilbur has weakened much, at least not in his formal utterances. He has all along avowed entire toleration of labor unions. He states a little more explicitly his willingness to confer with employees who represent others *in their own branch of the road's service;* but he probably never denied the men this right when it was claimed in a decent manner, if he ever did at all. The only feature of the settlement that the strikers can claim as a victory is the company's promise to employ them as new men without prejudice, and to promote them as freely as it does the other new men "without distinction *on account of seniority* of service or otherwise." In the nature of the case these concessions could not have been granted before the strike. If "federation" and the advantages supposed to go with it were what the strike was started for, its failure is complete. The generosity of the company to the strikers is, indeed, a considerable favor; for a stranger employed Dec. 1, 1893, will have no advantage over a striker, equally competent, who comes back, say, Dec. 1, 1894. Very possibly the road could have fought the fight through and won, even without this concession but it had lost a great deal of money and wisely conceded something, and so the strikers were forgiven a good deal. Now the question for railroad officers is, Has the victory of the road cost more than it is worth? The operating officers had a very hard time during the 2½ weeks that the old men were out. Collisions and boiler explosions destroyed much property and killed a number of employes. Besides the direct cost these accidents frightened away passengers, delays diverted freight and the total loss of earnings will be serious. If, added to the money loss, we give due weight to the risks and anxiety involved, it is easy to say that the cost of such a strike *is* too great. But so far as we can see it was one of those very expensive, but very necessary, steps in social education which may be seen in every year's history of the progress of human society. The trade union is probably a good thing; it certainly will be a necessary thing for more years than anyone can see ahead; but it cannot take command of industrial affairs. It, too, must recognize the rights of other folks, and probably it can only learn its proper place in the world by the old process of defeat and suffering. No price is too great to pay to get the result that every man, even the non-union workman and the railroad shareholder, shall enjoy his rights in the world. In the present stage of industrial progress the only visible way of keeping the unions from becoming unbearable tyrants is to fight them and beat them.

Mr. G. H. Thomson's theory of structural motion as developed in the article on the Stockport Bridge published elsewhere seems to us only an argument for heavier and stiffer structures. What Mr. Thomson has done is what nearly every engineer is doing, though he may not explain his acts or the views that prompt them by theories of "structural motion." Most men will fail to see how or wherein the methods and practice of Mr. Thomson are different from those usually employed by bridge designers. Until the laws of "structural motion" are understood and their effect upon materials determined, he is merely exercising his judgment, as every engineer is bound to do. Some engineers pin their faith upon the theory of the fatigue of metals and adopt Launhardt's and Weyrauch's formulæ with a liberal factor of safety; others pretend to modify their designs according to the laws of impact and resilience, based upon the theory of the conservation of energy; and there are many who are content to simply apply such a factor of safety as their experience and training dictate. The objection to "structural motion," as described by Mr. Thomson, is that it is so loosely defined and comprises so much that it cannot be treated under any one head or subject, and it must therefore be confused and almost impossible to investigate. Launhardt's and Weyrauch's formulæ are the result of physical and mathematical deductions from scientific experiments, and the ground upon which the theory of elastic vibrations and resilence is based is well understood. Mr. Thomson's structural motion has yet to be investigated and made a science. He has entered upon a new field, in a territory unexplored and in an atmosphere of refinement where the average engineer will not care to follow. His ideas are presented in the hope that somebody will enter this new field, perform experiments and acquire such information as can be employed to ascertain the relations between structures and the dynamical impulses to which they are subject. Before doing that the scope of the subject will have to be limited. Engineers will confess that the present method of adopting an arbitrary factor of safety is far from being satisfactory, but it is no doubt better than to risk the safety of a structure to theories not well defined and understood. This may not apply to the structure in hand, which is supposed to have been designed according to the best practice and then to have been given a touch of the engineer's personality. Probably most engineers give to their designs something of the benefit of experience after they have completed their calculations, and so long as the modifications add to the strength and security of the structure no harm is likely to come from it, whether their notions be based upon old or new theories.

The magnitude of the private car abuse is forcibly shown in the recently published statement of the Interstate Commerce Commission that the mileage paid on such cars amounts to $30,000,000 a year. If these cars earn an average of $280 each, there are thus about 107,000 of them in use. Car service men will have to bear in mind that it will not be child's play to kill out an interest so powerful as this indicates. The sum we have named ($280) was the average earned by some livestock cars as published two or three years ago. Perhaps refrigerators do not earn quite so much as this, and it is quite certain that coal and coke cars do not, but the evil is bad enough at best. Where the mileage paid is one cent instead of 7½ mills, the case is worse than we have indicated. It will be remembered that at the last meeting of the American Railway Association it was proposed by the Committee on Car Service that a letter ballot be taken on the proposition that the rate of mileage paid on all freight cars be reduced from three-quarters of a cent to half a cent a mile. This letter ballot is now being taken, and it will be interesting to know the result, as *anything*, even a straw, that shows promise of abating the present evils is worthy of note. Doubtless each railroad is figuring up the result of such a change to itself, and doubtless each one of them has by this time discovered that the amount paid for the use of private cars will, under the new scheme, be reduced by one-third. This would be a clear gain to each road using such cars, and the fact will probably affect its vote except where its decisions are influenced by owners of private cars, who doubtless fully understand that it is proposed to reduce the income of their car investments by one-third. Such influence would be potent on a road where one or more owners of private cars have representation in the Board of Directors. All railroads that are not thus influenced, and these are probably in a large majority, would see one distinct advantage in reducing the rate. On the other hand, the railroads whose car service balances are on the credit side, will see that balance cut down one-third by the new plan. If we could assume that half the railroads have a credit balance and half a debit balance in their car service account, the advantage gained by every road which uses private cars, in the reduction of payment to the owners of such cars, would seem to be sufficient to so turn the scale as to insure a majority in favor of the new scheme, unless the influence of the individual car owners is more important than one would imagine. It is possible, of course, that the railroads in favor of a per-diem system may see in this proposition a covert attack upon per diem. The Car Service Committee of the Association, while it has varied its position as to the per-diem rate recommended, has hitherto been steadfast in its recommendation of a mileage rate of one-half cent. If, then, this rate is to be reduced, the mixed per-diem man may abandon all hope of having any per-diem charge added to the mileage rate. Possibly the opposition of

per-diem men who, on this ground, argue against the reduction of mileage as now proposed, may be sufficient to kill the scheme; but if, as seems possible, such mixed per-diem men are chiefly representatives of roads which now have a credit balance, their opposition should not be effectual. There seems to be nothing in the scheme to provoke the opposition of the straight per-diem men, and it would not be surprising to find that most mixed per-diem men were at heart in favor of straight per diem.

Boiler Inspection at the New York Railroad Club.

It is a long time since a club paper has excited so much discussion as the recent paper on locomotive boiler inspection and construction, by Mr. D. L Barnes, before the New York Railroad Club at the October meeting. The paper was discussed at the November meeting, and with discussion will be found in full in the Proceedings for the two months. A synopsis of what was said in the paper and in the discussion will be found in another column of this issue.*

On the whole there seems to have been a misunderstanding about the meaning of the paper. It was long and much condensed, and probably considerable explanatory matter was left out. As we understand it the principal point of the paper was that locomotive boilers differ greatly in construction, the better class requiring less inspection than the others. With this in view the author has divided boilers into three classes, the first requiring but little inspection, and the second and third classes requiring much more inspection; the inspection being dependent upon (as explained in the paper) the locality in which the boilers are used.

There was little or no discussion about the rules of the inspection of the first class except in the matter of the removal of dome caps. The requirement was that dome caps be removed and the throttle pipe taken out once every six months, so that the braces above the tubes could be examined. This was objected to by some of the speakers; but the indisputable and stubborn fact remains that the printed instructions of railroad companies at the present time do in some cases call for the dome caps to be removed and the boilers examined in the bracing *once every three months*. It may be that the paper had an ulterior motive, and was intended to indirectly call attention to the faults in the printed rules of railroad companies for inspection. Probably it would have been better if the paper had called attention in a more prominent way to the fact that the rules of inspection were taken directly from the printed instructions of several of our largest railroad companies without any important change in the wording. But there might have been less discussion if this fact had been known, and therefore some of the valuable criticism obtained from the members of the New York Railroad Club would have been lost.

Naturally enough such a radical proposition as dividing boilers into three distinct classes—good, medium and bad—will not be accepted by railroad men without protest, more particularly for the reason that no master mechanic wants to acknowledge that he is running any "bad" boilers, although he would probably be willing to admit that he isn't quite dead sure of a good many of them.

Those who have read the rules for inspection for the second class boilers will not be surprised that they were objected to as the amount of labor and time required to carry out these rules (which were taken from railroad companies printed instructions) is something appalling, but perhaps this is an argument for using better boilers requiring less inspection. It is not probable that the railroads which have issued these instructions will take the responsibility of reducing the amount or completeness of their inspection by eliminating any important detail from the directions already sent out.

Those who discuss the rules for inspection given in the paper should remember that what is necessary inspection where the water is bad and the boilers are much driven will appear to be a useless waste of time and trouble to those who have charge of boilers where the trains and grades are light and the feed water practically pure. The paper says, regarding this point: "Special cases or conditions of unusual severity, such as very bad water or unusual forcing of the fires, require shorter intervals between inspections."

There was some discussion about the causes of explosion; one speaker incorrectly assumed that the writer of the paper claimed that hot crown sheets caused the explosion by the generation of a vast amount of steam when water was thrown on them. This theory was exploded long ago by the experiments of the United States Government and others. Hot crown sheets cause explosions because the material of the sheet is weakened when overheated. One speaker incorrectly assumed that the paper advised putting in screwed crown stays without riveting over, but this never has been done and probably never will be. It was also assumed that the paper said that in case of an explosion all of the water exploded into steam. The paper reads: "As soon as an opening is made the rapid escape of steam causes a sudden lowering of the pressure, and a part of the heated water bursts into steam."

There was considerable criticism of that part of the paper which practically said that inspectors are not generally competent men, and that inspection is frequently performed by boys. It is not to be wondered at that some master mechanics do not like this imputation, but on the other hand that it is true, in some cases at least, is shown by the remarks of one of the speakers who said: "This morning we had the flues out of an engine more than 20 years old. We took the stand pipe out and got a *boy* in the boiler to examine it. The boiler, so far as *we* were able to see, was in perfect condition." To whom the "we" refers is not clear. Perhaps it is the boy, anyway the boy did the inspection, q. e. d. The same speaker offered as proof of the admirable Pennsylvania Railroad design and construction of boilers that they had not had an explosion in 20 years. Perhaps it may be that this desirable result was brought about by good inspection equally as much as by good design and construction, and it may be that the Pennsylvania Railroad does not use boys.

Mr. Mitchell's remarks about classification are very interesting, and while he does not agree with the classification, yet he gives facts that show that boilers are not all equally good, and acknowledges that a great many stays in first-class boilers are inaccessible. The difference in inaccessibility of staying is in itself an argument for more than one class of boilers. The difference in accessibility of the staying in crown-bar and screwed stay boilers is sufficient of itself to place the boilers in a different class, so far as inspection is concerned, the screwed crown-stay boilers belonging in a higher class. Anyone will appreciate this who has ever been inside of boilers of the two types. The Belpaire and the radial-stay type of boiler will probably always rank higher than the crown-bar type, at least this is the opinion of the most experienced locomotive builders and superintendents of motive power. Mr. Mitchell has said that he has boilers over ten years old that are "as good as when first built." This is certainly remarkable, and, as he says, it is more especially the case with boilers that run in "good water districts, where boilers will run for three months without washing and then only show very little impurities." Ten years of service, however, in the average Western country will bring a boiler to a pot in where its condition demands the most complete inspection, to say the least, and frequently it must be put in a lower class than boilers that have been used but five years. The improvement in methods of construction, in material and in design, in a period of ten years, will alone make a new boiler, if of the most improved design, of a higher class than one that is ten years old. Probably ten years is a safe point for a change in classification, if the boiler has been intelligently used and well cared for.

Mr. Mitchell objected to the requirements of boilers of the first-class because there was no means of detecting laminated sheets. The paper said on this point: "Laminations are not dangerous, but if bulges resulting from laminations are not removed the boiler may finally become dangerous." There is some difference in opinion about the evil of lamination in boiler sheets, but the gist of it all seems to be—and we are now taking into account the opinion of boiler builders and steel plate makers, as well as boiler users—that laminations in shell sheets do little or no harm and are not dangerous. The ordinary inspection for lamination by etching the edge of the sheet or by nicking and bending, is quite enough for shell sheets. The presence of lamination in the middle of a sheet cannot be detected by this examination, and therefore it has been concluded that there is no means of detecting laminations that will meet the requirements for firebox plates. When the lamination is very bad it can be detected by heating the sheet all over. Then during cooling, and sometimes during heating up, the lamination can be detected by the appearance of a black spot on the sheet. The evil resulting from lamination of firebox sheets is not that it puts the boiler in a dangerous condition, but that it causes expense and delays during patching or renewal of sheets. He cannot find on record a single case where the lamination of a steel sheet has caused the explosion of a locomotive boiler, nor a case where lamination has made a boiler dangerous in a part or detail where it would not be quickly discovered by the ordinary examination by the roundhouse force who do, or should, examine the firebox in a general way at very short intevals.

Mr. Mitchell said: "It is impossible to print rules entering into all details of inspection . . . The education of inspectors depends more upon their experience." This leads us to ask the question whether it would not be better to put this experience on record in some form, so that it could be made available for the more rapid education of inspectors? A parallel case is found in air-brakes. At first "experience" was about all that inspectors had to guide them, but now that "experience" has been printed and occupies several pages of the reports of the Master Car Builders' Association, it is not clear why the experience of locomotive boiler inspectors should not be recorded in the same way. No railroad company has an abundance of competent and reliable inspectors, and it frequently would be useful if the experience of inspectors, so far as it can be written out, could be put into the hands of beginners, for, as we understand it, an inspector some time in his life must begin to get his experience, and the shorter the period of this beginning, the better for the railroad companies. Probably nothing would so facilitate the making of experienced inspectors as to put into the hands of beginners as much printed matter relating to the inspection and construction of locomotive boilers as can be expressed in words.

The matter of hollow or solid stay bolts, and the proper dimensions, is evidently still a useful topic for discussion. There is no universal agreement as to the value of hollow bolts. Some argue that a hollow bolt needs no hammer test, for the reason that if it breaks the breakage will be revealed by the escape of steam; and further, if the breakage takes place so slowly that the crack is filled with scale and therefore steam cannot escape, yet steam will escape and the breakage will be made known when another staybolt near it breaks and permits the sheet to move outward and open the crack in the first bolt broken. It is argued that one or even two broken staybolts in a well designed boiler is not dangerous condition. Others argue that hollow bolts when broken do not let steam escape because the cracks become filled with scale. It is undoubtedly true, however, that in a majority of cases a broken hollow staybolt will make itself known.

The lack of knowledge about the relative durability of large and small staybolts inserted in different ways, that is, with sharp threads screwed in tight or with round threads with an easy fit, is evident from the discussion. One speaker cited a case where a railroad company claimed it had had but two broken staybolts in 51 boilers in seven years, the reason for this good performance being that the water was pure and the staybolts were large. The same speaker argued that because he found "a staybolt 1⅛ in. in diameter that was broken, . . . it would be of little use to make the staybolts large." What is perhaps more expressive about the present situation is the following remark of the same speaker: "When we had the old wood burning engines they were hot and cold all the time, and we ran them for years, and you hardly ever heard of a broken staybolt. But to-day we are finding them all the time, and I do not quite understand it."

The difference in the conditions between the days of wood-burning and the present time is very great. The staybolts are of the same size that they used to be. The sheets are nearly twice as thick for the outside shell, and therefore much stiffer, and the whole movement is practically confined to the staybolt. The sheet bends but little. The fires are now hotter, and as a rule there is more scale on the firebox sheets, which permits the sheet to get much hotter and expands more than was formerly the case, hence, as the sheets are larger in area, which gives more total expansion, and the steam pressures are fully 50 per cent. higher, which throws more strain on the staybolts, there are some good reasons for the cracking of staybolts. The expansion of a firebox sheet must be considerable when it gets so hot, as in some cases where there is considerable scale as to bulge between staybolts. Probably there are reasons enough for broken staybolts, if we would take the time and trouble to search for them. The Pennsylvania Railroad Co. has taken the "bull by the horns," so to speak, and completely stopped the breakages of staybolts in some of its boilers by using a ball-joint connection between the stay-bolt and the shell sheet at the point where breakages most frequently occur. It is said that where this plan has been adopted the breakages are entirely removed. The additional expense is very small, as the design is simple. The cost is as nothing compared to the decrease in the expense of delays due to broken staybolts on a road where the

* The discussion will be given next week.

printed instructions require that "no locomotive must be allowed to remain in service when there are one or more staybolts broken in the top row."

To locomotive builders the brief discussion about the need of railroad companies sending inspectors to locomotive contract shops will be interesting. There was a time when locomotive builders did most cordially hate a railroad inspector. He was certainly a very inconvenient person to have about, but now the most progressive builders have become so familiar with the requirements of railroads and so fully appreciate the real value of turning out a locomotive ready for immediate service, and in a manner which removes all or nearly all after-disputes, that they welcome intelligent inspectors. Of course, no locomotive builder wants to be bothered with incompetent or hypercritical inspectors, or with young men or boys who are sent to be taught inspection; but they are glad to be relieved of the large responsibility which is usually taken by a competent railroad inspector. On the other hand, the railroad companies have learned that it is absolutely necessary, in order to get what they want, and to prevent disagreeable disputes after locomotives are put into service, to send to the building shop a competent inspector equipped with full instructions how to act, and any railroad company, large or small, which buys locomotives without inspection on its own part, does so only because its relations with the builders and confidence in them leads it to believe that special attention will be paid to its order.

Locomotive building has improved greatly in the last ten years, and now the builders are able and competent to do just as good practical workmanship with contract labor as railroad companies can do at their own shops. All that remains for the railroad companies to do is to see that the good work is done, and to accomplish this an inspector must be employed. We do not mean to say that bad workmanship is not turned out of locomotive building shops at the present time, as this would be contrary to the facts, and no master mechanic would believe it, because it would be opposite to his experience; but what we do say is this, that locomotive builders are trying hard to do good work, and competent railroad inspectors are a necessity and assistance, and are welcomed by the best and a majority of the builders in this country.

Those who are interested in grooving, pitting and corrosion of boilers will find some interesting talk in the discussion. One of the speakers said that the paper did not take up the matter of grooving, but probably he had not read that portion of it. The lantern slides showed many examples of corrosion, and some of the results that follow. Up to this time the most reasonable explanation of pitting, grooving and corrosion in spots is probably that it results from the uneven character of the material. In places where there was a defect in the ingot it is certain that corrosion goes on more rapidly, but, on the other hand, in apparently uniform sheets the corrosion does not take place uniformly any more than a knife blade rusts uniformly. Oxidation and corrosion do not proceed uniformly under any circumstances. Note the pitting of iron work, anchors, etc., that are buried under water. Sheet metal does not rust through all over at the same time, but generally the rusting goes on in spots while some of the material remains unaffected.

The question of fusible plugs brought out some interesting facts. It is evident from much testimony gained from various sources, that locomotive engineers do not look with favor upon fusible plugs, mainly for the reason that they melt before the crown sheet is hot enough to discolor it, and thus the fusible plug acts as a telltale about the water line that is very disagreeable in some cases. That a fusible plug is a safeguard, when properly maintained, requires no explanation here. The fusible plug, if properly made, will melt and save a disaster from an overheated crown-sheet when the plug is in proper condition. This is indisputable. The cost of maintaining fusible plugs by screwing them out of the boiler and refilling frequently, is too small to be worth talking about. The almost certain security from disastrous results from hot crown sheets that is obtained from the proper and intelligent use of fusible plugs is so valuable that the cost of time and material to maintain the plugs practically disappears in comparison. There is only one conclusion, then, and it is the same that has been reached by the United States Government, the English Board of Trade and boiler insurance companies all over the world, namely, use fusible plugs and take proper care of them. The remark made by Mr. West, of the N. Y. Ontario & Western, that fusible plugs are "a detriment and dangerous to the crown sheets," needs no comment.

As is usual in the case of boiler inspection discussions, the hydraulic test came in for a considerable share of attention. This is a matter that has been discussed so often before, and without agreement, that there is not much hope of getting all boiler users to think alike about it. The facts are something like this: Boilers are designed to stand from three to five times the working pressure; and it is pretty generally conceded that it is not safe to run a boiler continuously that has not an ultimate strength fully three times the working pressure. Now, the argument is that a hydraulic test, to show that the boiler is safe, should be run up to at least two or three times the working pressure; but, of course, this would tend to strain the boiler and would not be advisable, yet it was done recently by a locomotive builder to show that the staying in some suspected boilers was correct. The boilers were guaranteed for 100 lbs. pressure, but one of them failed in the crown sheet, and the master mechanic claimed that the failure was due to bad bracing, while in fact the explosion resulted from a hot crown sheet. The other boilers of the same order were tested at 300 lbs. pressure to satisfy the railroad president. Such hydraulic tests are undoubtedly bad for a boiler, but any lower test only proves that the boiler is tight if it does not leak. However, this matter is one that can be discussed indefinitely in the future as it has been in the past until there is an agreement about what a hydraulic test is for. Is it to test the safety of the boiler or its tightness?

The insertion of crown stays for crown bar boilers so that they will pull evenly has long been a problem with boiler builders. The Pittsburgh Locomotive Works which are now making a specialty of boiler construction, have decided that the multitude of crown stays cannot be put in with anything like uniform tension without a turn-buckle in the stay, and this is now their regular practice. The difficulty of putting in the stays in the old fashioned way is perhaps well illustrated by the remarks of one of the speakers, who said: "In case they do not fit exactly right we have a pin swedged to one-tenth or one thirty-second smaller than the others to have an equal strain on all of them." It is scarcely to be expected that boiler builders generally will take the time and trouble necessary to put in the bracing so carefully unless an inspector watches each stay, which is, of course, impracticable, as there is scarcely room in the boiler for two men at the same time. With the screw stay for the crown the tension is practically uniform throughout.

Mr. West wanted the club "to put itself on record as being opposed to this system of inspection that Mr. Barnes has outlined. I think it is entirely impracticable. I do not think there is a road in the country that can stand it." Mr. Lewis, of the D., L. & W. said "as to the inspection I do not see how any railroad can comply with the recommendation in Mr. Barnes' paper." Mr. Joggins, of the Norfolk & Southern, said: "So far as the rules laid down for inspecting boilers are concerned, I do not at all agree with them."

One might well question whether these speakers remembered clearly what the paper said, but possibly they did not understand that the rules for inspection given in the paper for the second class of boilers were copied almost without change from the printed rules which railroad companies are now issuing to their employes and which are supposed to be followed. The inspection for the first class of boilers is so much less than the inspection for the second class that it almost seems as if the speakers must have mixed up the classes.

A Neglected Duty.

We wish again to call attention to certain neglect of that part of mechanical engineering which has to do particularly with railroads. This time our remarks are prompted by the failure to act of some organizations which have more or less the dignity of this branch of engineering in charge. Outside of the technical papers there is mighty little information that will assist the railroad mechanical engineer in dealing with his own problems, and universities and schools have been compelled to put in experimental apparatus to determine some fundamental facts about locomotives and other devices used on railroads that ought to have long ago been recorded as the results of investigations made by individuals and prompted by a broad and liberal action and policy on the part of engineering societies and associations. The value of experimental research is well indicated by the results of tests with the locomotive at Purdue University given in these columns last week.

The relative merits of compound and single expansion locomotives have been discussed until folks are tired of the topic, and scarcely a fact has been proved excepting that where single-expansion locomotives are overworked the compound locomotive will effect an enormous saving in fuel and in wear and tear of boilers but this every well informed steam engineer was able to prove to his own satisfaction before a single compound locomotive had been built. To get some definite knowledge about such locomotives a committee was appointed by the Master Mechanics' Association last June and authorized to collect money to conduct experiments tending toward the solution of the problem of compound vs. single expansion locomotives. Five months have passed and nothing of the slightest importance has been done yet. The committee was instructed to confer with the American Society of Mechanical Engineers to gain their joint action and their supervision of the test. But that Society, disregarding the fact that many of its members are deeply interested in the matter, and favor joint action, finally decided to have nothing to do with it, offering as an explanation and excuse that the Society could not afford to take part in anything that would be a competitive test of patented devices or to do anything that would interfere with the professional work of its members.

It would seem that nothing but an increase of the importance of the mechanical engineering profession could come from a supervision of such important tests as those proposed. Those who guide the American Society of Mechanical Engineers need only to have looked into the work done by the most prominent engineering associations in this and in other countries to have found a precedent. So far as patented devices are concerned, the excuse does not apply in this case, for there is not a single compound locomotive running in this country on which there is a patent on the steam distribution or anything else of any importance but the starting apparatus, which apparatus it was not intended to test.

To learn how the American Society of Mechanical Engineers acts toward patented appliances and how the Society has neglected railroad mechanical engineering, one has only to turn to its proceedings. For the last three years only about 5½ per cent. of the papers or communications have related to strictly railroad work, although the individual horse power of many locomotives is as great as 1,000, and the combined horse power of the locomotives of this country is greater than the combined horse power used for all other purposes. More than this, locomotive design and manufacture, the laying out of railroad shops and the construction of cars, cranes, signals and special mechanical appliances used on railroads, require the highest order of mechanical engineering talent. Note also the great variety of engineering laboratory and dynamo-meter work that has been done and which has been published only in the technical papers and has not appeared in the Proceedings of the American Society of Mechanical Engineers.

It is not to be wondered at that railroad men have formed their own societies, and that the railroad clubs are to-day doing a work that would otherwise have been done by the engineering societies had they given railroad mechanical engineering the attention and consideration which it deserves. In a comparison of this kind, the American Society of Civil Engineers stands out with great prominence. Its proceedings have recorded very much of the important railroad civil engineering work that has been done. Thirty per cent. of its papers for the past three years have been on strictly railroad subjects. So long as the American Society of Mechanical Engineers maintains its present apathy toward railroad mechanical engineering, that important branch will continue to be best set forth and expounded in the technical railroad journals. Perhaps eventually the railroad clubs will become a strong engineering association; at least this is now indicated by the present plan which they have of joint action and interchange of proceedings.

Annual Report.

New York & Brooklyn Bridge.—The business year of the New York & Brooklyn Bridge Trustees ends Dec. 1, 1893, and the report for the year just closed is issued with remarkable promptness. The receipts from operation are given in the table below:

Year.	Drives.	Railroad.	Total.
1892	$83,733	$1,144,996	$1,228,729
1893	85,410	1,167,498	1,252,908
Increase	$1,677	$22,502	$24,179

The passengers carried were 42.6 million in 1893 and 41.8 million in 1892.

The receipts and expenditures were as below:

Receipts:		
City of Brooklyn construction account	$150,000.00	
City of New York " "	75,000.00	
Receipts from tolls	1,252,908.04	
Material sold, labor, etc	559.91	
Interest	2,426.03	
Rent, real estate and telegraph wires	109,216.65	
		$1,590,140.03
Balance on hand at last Report		439,311.53
		$2,029,451.56
Expenditures:		
Construction account	$222,949.58	
Pay rolls, 12 months	680,223.91	
Salaries, 12 months	46,971.42	
City of Brooklyn, on account, surplus	400,000.00	
City of New York " "	200,000.00	
Supplies, etc	105,760.32	
		$1,655,908.23
Balance on hand Dec 1, 1893		$373,543.33

The principal items of expenditure for construction were about $40,000 for the New York and Brooklyn extensions, $17,000 for a new engine house, $50,000 for new engines and $61,000 for the Brooklyn extension. The legal proceedings for the acquisition of the property for the Brooklyn extension are pretty nearly set-

tled, and it is expected that during the winter this obstacle to the completion of the improvement will be removed.

Up to last April the management of the affairs of the bridge was vested in a Board of Trustees, consisting of eight persons appointed by the Mayor, Comptroller and City Auditor of Brooklyn, and eight persons appointed by the Mayor, Comptroller and President of the Board of Aldermen of New York, and of the Mayors and Comptrollers of the two cities. An act of the legislature passed last April replaced this board by a new board, consisting of two persons appointed by the Mayor of Brooklyn and two appointed by the Mayor of New York, the appointing officers also being on the board, *ex-officio*. This, of course, centralizes the power, but we are not prepared to say whether or not the change has been, or is likely to be, an improvement.

The operating management of the bridge railroad has certainly been successful. In ten years it has carried 304.9 million passengers and no one has been fatally injured in transit. The accidents which have occurred have been principally rear collisions at stations. The time lost by delays from all causes has averaged 45¼ seconds in each 24 hours or one minute for every 154,658 passengers. Thirty-eight per cent. of these delays was due to failure or defect in some part of the cable machinery, the remaining 62 per cent. having been due to accidents common to ordinary railroad transportation.

The greatest number ever carried in one month was 4,033,920, in October, 1892, which included the week of the Columbus festival. The next greatest number was 3,846,493 in May of this year. The greatest number carried in one day was on Oct. 12, 1892, when 222,625 were carried. The smallest number carried in one day was 45,280, on the 20th of last August.

An interesting fact, shown incidentally in the report, is the decrease of business due to the general financial depression. This is shown in the little table below, which gives in millions the numbers carried in the first eight months of each fiscal year, and in the last four months in the same years, with the increase or decrease, as compared with each preceding year.

	1890-1.	1891-2.	Inc. p. c.	1892-3.	Inc. or dec. p. c.
Eight months	26.4	27 6	I. 4.4	29.1	I. 5.5
Four months	13.3.	14.1	I. 6.3	13.5	D. 4.8

It will be observed that there was an increase this year of 5½ per cent. in the first eight months, and a decrease of 4.8 per cent. in the last four months. The greatest decrease was in October last, which amounted to 9.7 per cent. In November the number transported had picked up so that the decrease as compared with last year was but 1.7 per cent. This is the only time in the history of the operation of the bridge railroad in which travel has decreased as compared with the corresponding time in a preceding year. Valuable tables are published showing the hourly travel for 24 hours for one day in each year from 1886 to 1893 inclusive, the figures being given for passengers each way and totals. Similar tables are given for vehicle travel also.

In the 10 years and 67 days that the railroad has been operated eight hauling cables have been in use, of which six have been worn out and removed, and a table is given showing the service of each one of thess cables. The greatest mileage made by any one of them was 228,329 miles, and the greatest ton mileage was something over 35 millions. This was not made by the cable making the greatest number of miles.

A paragraph of considerable interest is with regard to a change of motive power. It appears that last September engineers were directed to make a careful examination of the installation of the Intramural elevated railroad at the World's Fair and make a report upon the question of the substiution of electric for cable power on the bridge. The engineers' report has not been formally presented, but the opinion is that the results of an examination do not justify a change at present, involving an expensive and perhaps doubtful experiments.

The latest issue of the *Mémoires* of the Civil Engineers' Society of France which has been received, that of October, contains the story, by Mr. Louis Rey, of the visit of a delegation of the Society to the United States in September and October of this year. Mr. Rey, it will be remembered, was the President of the delegation. His account of the visit occupies 30 pages of the *Transactions*, and yet it is necessarily only a very summary review of their journey, rather an itinerary in fact than anything else, and it is given to the Society merely as a record. It will be remembered that about 40 of these gentleman arrived at New York Sept. 3, spent several days here, visited Chicago and the World's Fair and returned by the way of Pittsburgh, Washington and Philadelphia. While in America they were the guests of the "Eighty-niners," a provisional organization of the engineers who had received so much hospitality from foreign engineers in 1889. Mr. Rey concludes his official recital of the chief events of the journey with an expression of the great pleasure and profit that the delegation had in its visit. The gentlemen of the delegation found their reception most hospitable and their whole journey agreeable and instructive beyond anything that they had anticipated.

TECHNICAL.

Manufacturing and Business.

The Universal Coal Dumping Car Co., of Springfield, Ill., has been chartered by T. Henry Pearce, James A. Philbrook and Ralph W. Philbrook.

The Laidlaw-Dunn-Gordon Co., of Cincinnati, has secured the contract for two water works pumping engines for Harriman, Tenn., and one horizontal compound for water works at Fernandina, Fla. This makes 16 water works contracts that have been secured by this company since June 15 last.

The Billings & Spencer Co., of Hartford, Conn , has opened a Western office at 59 South Canal street, Chicago, in charge of Mr. W. Davis. A complete line of goods will be shown there.

The Billings & Spencer Co., of Hartford, has disposed of its interest in the Spencer nail puller. In future any information regarding this device may be obtained by addressing C. M. Spencer, Windsor, Conn.

The Falls Hollow Staybolt Co., Cuyahoga Falls, O., has appointed J. and H. Taylor, 751 Craig street, Montreal, agents for the Dominion of Canada for its patent mandrel rolled hollow staybolt iron.

The Gould Coupler Company has purchased the Wadley continuous drawbar, which has been controlled by the Wadley Continuous Drawbar Co., of Savannah, Ga. Mr. George D. Wadley, formerly General Superintendent of the Central of Georgia, is one of the inventors. The drawbar is already used on a number of roads. The Gould Coupler Co. will, doubtless, increase its success.

The Receiver's sale of the property of the American Steel Wheel Company, which was announced to take place at Garwood, N. J., on Dec. 13, has been adjourned to Jan. 10, when it is hoped that better prices will be realized and a sacrifice of the property avoided.

The directors of the Railroad Lighting & Manufacturing Company of Philadelphia wish it distinctly known that they disclaim all knowledge of the origin of the apparently systematic attempt to circulate among railroad officers newspaper reports of alleged explosions of gas used in lighting cars. They have formally and explicitly denied that the circulation of statements has been instigated by the officers of the company, as they say has been alleged.

Iron and Steel.

The Colorado Fuel & Iron Co. has contracted with the Receivers of the Union Pacific for the delivery of 26,000 tons of rails. This order will result in the employment of about 1,500 men at the company's works at Pueblo, Col.

The Crane Iron Company, whose furnaces are at Catasauqua, Pa., has assigned to Robert F. Kennedy, of Philadelphia, and Leonard Peckitt, of Catasauqua. The company was affected by the numerous other failures in the iron trade, and has quite a large sum owed to it by concerns which are in the hands of receivers. The immediate cause of the failure was a default on the interest payable on Nov. 1. The Crane Iron Company was incorporated in 1839, and has an authorized capital of $2,000,000, of which $1,500,000 is paid up. The plant at Catasauqua consists of four blast furnaces, erected in 1839-46, and remodeled from time to time.

The Pennsylvania Steel Company has countermanded the order recently issued closing down the works at Steelton, Pa., from Dec. 22 to Feb. 1, 1894. Orders have been received to keep the works in operation for some time, and the date of the shutdown has been postponed until Jan. 1.

New Stations and Shops.

Plans have been completed for the new plant of the Westinghouse Electric Co. to be erected near Pittsburgh. The following buildings are included in the plan: A machine shop 75 × 231 ft., two stories; warehouse, 76 × 754 ft.; foundry, 150 × 700 ft.; shop, 75 × 300 ft.; powerhouse, 76 × 300 ft.; a punch department, 76 × 250 ft., and others.

The Chicago Main Drainage Canal.

Trustee Frank Wenter was unanimously re-elected President of the Board on the 5th inst. In his annual report he said, in part: Work on 20 miles is now under way and five miles additional is about to be contracted for. The right of way from Summit to the Chicago River at Robey street is almost entirely secured by mutual agreement. The total area acquired by the district for right of way amounts to 5,895.43 acres, of which 2,183.7 was condemned. The total cost to Dec. 1 last was $1,762,419.89, or an average of less than $300 per acre. This right of way varies from 808 to 5,285 ft. in width. The total payments for construction up to Dec. 1 were $1,969,739.82 for excavating 3,119,208 cu. yds. of glacial drift and 1,541,239 cu. yds. of solid rock. All but about $95,000 has been paid out during the fiscal year of Mr. Wenter's administration.

The trustees are arranging to have a Congressional inspection of the canal on the 28th inst, hoping that Congress will assume the construction of a navigable channel below Joliet so that traffic may be accommodated about the time the sanitary work is completed. This work will cost some $30,000 and will be at the sole expense of the Chicago Drainage district.

North River Front Improvements.

The Pennsylvania Railroad Company has applied for permission to build a sea wall on the North River between Eleventh and Warren streets, New York, at its own expense under chapter 397, laws of 1893. The wall will pass through Desbrosses street ferry, filling in the gap between Canal street and Laight street, except between Canal and Watts streets, for which arrangements are nearly made. When this is done the new improvements on the North River will be continuous for 1⅛ miles. The New York Dock Board granted the request, and also gave permission to build a sea wall in front of the railroad company's Cortlandt street ferry.

A Gyroscope Artificial Horizon.

An instrument recently patented by Capt. J. N. Rowe and C. E. Crane, of Seattle, Wash., will be of interest to navigators and engineers. Observations at sea for latitude and longitude depend upon a correct vision of the natural horizon or upon the unstable surface of a balanced dish of mercury, the former of which cannot be used in fogs or storms nor the latter in a rough sea. This new instrument may be used on deck or at the crosstrees and at any time the sun or stars are visible. The artificial horizon consists of a highly polished disc forming the top of a truncated hollow cone 2 in. in depth flaring at the bottom, which may revolve on a steel pin for a pivot, much like a common tea cup and saucer inverted and balanced upon a pencil. The pivot can be lowered and this female cone let down upon a male truncated cone that is connected with machinery and operated by a crank.

When the lower cone is rotated, the friction between the two cones causes the upper one and its disc to revolve at a very high speed, 3,000 revolutions a minute, when it is raised upon the pivot by a lever. The center of gravity being below the point of the pivot, the axis of the cone assumes a vertical position, and the disc a horizontal position, and the gyroscopical action of the cone and disc maintains it in that position, though the pivot may be inclined within the limits of the cone. It is used when revolving thus freely. The principle is the same as is employed by jugglers to balance an inverted bowl on a pointed stick.

The Navy Department has given the instrument a trial on the U. S. monitor Monterey and it has received high praise from its officers. The instrument is also valuable to determine at what moment a gunboat is level, that the signal may be given for firing the guns, and it may be used in the conning tower. The instruments are made of aluminum-bronze.

The "James Toleman."

The Winby locomotive "James Toleman" will very soon be put in service on the Chicago, Milwaukee & St. Paul between Chicago and Milwaukee, hauling passenger trains. The reader doubtless remembers that this is the double barrel, four-cylinder locomotive designed by Mr. Winby exhibited at the World's Fair; and he will remember also that the designer has been very anxious to get competitive trials with locomotives of American design and build. It was supposed that the locomotive would be brought east to run on the Royal Blue trains in competition with the Baldwin compounds, and perhaps that will be done later.

Rack Railroads.

At the end of 1892 the Riggenbach rack system was in operation on 40 railroads. Fourteen of them are purely rack railroads. They have a total length of 34 miles, and their grades vary from 11 per cent. to 30 per cent., which latter is found on the Goncovado Railroad, of Brazil. Fourteen roads are partly adhesion and partly rack railroads. On 12 railroads the power is furnished by a cable, and the rack serves to hinder the cars from running down in case of an accident to the cable The maximum grade of the latter, of 61 per cent., is reached on the Hohensalzburg Railroad, at Salzburg.

The Abt system was in operation on 31 railroads, of which 9 roads, with a total length of 45½ miles, use the rack system only. Their grades vary from 8 per cent. to 25½ per cent., the latter on the Schafberg Railroad, in Austria. Eleven roads are partly rack, partly adhesion, railroads. The remaining 11 railroads use a cable, in case of a failure of which the rack is to prevent an accident. The maximum grade on the latter is 59 per cent., on the San Salvatore Railroad.

New York & New Jersey Bridge.

The conferees on the New York & New Jersey Bridge bill have agreed to a bill which places the New York & New Jersey Company, and the North River Bridge Company on the same footing, so far as privileges and obligations are concerned. To the Secretary of War is left the question whether the North River Bridge Company shall have a pier in the river.

THE SCRAP HEAP.

Notes.

The Boston *Journal* says that wages will be restored on the New York & New England on Feb. 1.

The Central of Georgia has discharged six passenger conductors because "their services are not satisfactory."

H. D. Smith, a ticket broker, of Detroit, has been arrested on a charge of selling forged tickets. It is said that in his office were found 40 tickets purporting to have been issued by the Maine Central to Western points.

The lower house of the South Carolina legislature has killed the bill which proposed to extend the powers of the railroad commission by giving it the same authority over express companies which by law it now exercises over railroad companies.

There was a small strike of freight trainmen on the Henderson division of the Louisville & Nashville last week, the grievance being that the company put on two engines to a train and ran longer freight trains than had been the custom, thus making less work for the brakemen.

The Baltimore & Ohio Railroad Company's World's Fair exhibit has all reached Baltimore, and is being stored at Mount Clare. It is stated that a formal tender of the exhibit has been made to the city of Baltimore, and that the question of its acceptance is now being considered.

President Roberts, of the Pennsylvania, last week issued a circular to heads of departments calling renewed attention to the depression in business and directing further reduction of expenses. Large numbers of men have been discharged from the general offices and from the station service in other departments.

It is now announced that the rule of the Lehigh Valley not to employ men over 45 years old as enginemen will not hinder the restoration of strikers, and the three men who were re-engaged and then discharged have now been taken on again. The Secretary of the Firemen's Brotherhood estimates that his association will lose $35,000 by the Lehigh Valley strike. At this rate the five brotherhoods—engineers, conductors, firemen, brakemen and operators—will probably pay out to their idle men a good deal over $100,000.

On Monday night last the express messenger in a Southern Pacific train was found murdered in his car near Liberty, Tex., with no clue to the murderer. The reports state that one safe containing a good deal of money was unlocked, but still containing the money, and that only a small safe was robbed. At Austin, Tex., on Dec. 18, four men who robbed a train of the International & Great Nortern at Duval, Tex., Dec. 10, were sentenced to 35 years' imprisonment each. This is the lightest sentence allowed by the law and "was passed in consideration of the fact that the men confessed and thus made a trial unnecessary."

Three passengers and two trainmen were killed and two passengers and three trainmen injured by the wreck of a passenger train on the Western New York & Pennsylvania, near Dunkirk, N. Y., on the night of Dec. 15, the train falling through a trestle bridge which has been undermined or weakened by a freshet. There were few passengers in the train, which probably accounts for the small number of fatalities, as the cars fell some 25 ft. and were badly wrecked. The engine crossed the bridge in safety, but fell down the bank after it got over. The three cars of the train all went down, except that the rear end of the last one rested upon the bridge floor.

Lake Traffic.

The average rates for freight paid during the past season were, according to Buffalo papers:

	Cents.
Corn, Chicago to Buffalo, per bushel	1.432
Wheat, Duluth to Buffalo, per bushel	2.339
Iron ore, Duluth to Lake Erie, per ton	77.297
Iron ore, Escanaba to Lake Erie, per ton	56.161
Coal, Buffalo to Chicago, per ton	45.944
Coal, Buffalo to Duluth, per ton	29.168

It is said that these rates for cheapness have no precedent for any extended period in the history of transportation. This fall in freight rates is ascribed by some to the addition last spring of 30,000 tons to the carrying fleet, but as the documented tonnage on the Great Lakes is 1,261,067 tons, this addition of 2½ per cent. does not seem large enough to account for the unsatisfactory freight rates. They are probably more due to the decrease in ore freights, and this is in great degree due to small demand for ore. Ore freights have been giving about half the lake freighting traffic.

Duluth and Superior are rejoicing in a very solid addition to their business. In addition to the new ore traffic, the lumber shipments aggregate 115,000,000 ft., as against 30,000,000 ft. in 1892. The flour traffic shows a gain of about 38 per cent. Shipments amounted to 6,129,000 barrels, of which about one quarter was manufactured at the head of the lake. Receipts of wheat for the season amounted to 26,703,000 bushels, as against 28,989,0 0 last year. Receipts of coal, which aggregates about 2,000,000 tons, were 100,000 tons in excess of those of 1892. A determined effort is to be made by the citizens of the two ports to get an appropriation of $2,500,000 for the improvement of the harbors at the head of the lake.

The coal shipments from Buffalo, by the Custom House reports, aggregate for the season, 2,703,673 tons, as against 2,852,330 tons in 1892. Of this season's shipments 1 180,245 tons went to Chicago, 555 995 tons to Milwaukee, 475,578 tons to Duluth and Superior, 27,450 tons to Canadian ports and the balance to various other ports. The soft coal shipments which were made from Toledo, Cleveland, Lorain, Huron, Ashtabula, Fairport, Sandusky, Erie and Conneant, cannot be ascertained with certainty, as a vessel clearing from one port is not obliged to report at an intermediate port, and the coal companies do not give out reports in all cases. The aggregate is, partly by estimate, 3,379,865 tons, so that the grand total will probably be in excess of the iron ore shipments.

It has been determined to launch the first of the Northern Steamship Company's large passenger boats on Jan. 3, and then work will proceed on the engines of the second boat.

The marine season on the upper lakes closed on Dec. 8 with the arrival of the package freight steamer Nichol at Duluth from Detroit. The season opened two weeks later than usual on May 8, and was therefore of just seven months' duration. During that time arrivals and departures of vessels at Duluth numbered 3,305, with a registered tonnage of 3,832,415 tons, and an actual freight tonnage of probably 5,000,000 tons. This is to be contrasted with arrivals and departures in 1892 of 3,846, and in 1891 of 3,056. Superior, whose business is closely identified with that of Duluth, had 2,100 arrivals and departures and a freight tonnage of about 3,600,000 tons, giving the combined port at the head of Lake Superior a total marine business for the seven months' season of 5,400 vessels and 8,500,000 tons of freight.

During the marine season 33,167,000 bushels of wheat, 6,195,000 barrels of flour, 120,000,000 feet of lumber, and 1,523,000 tons of iron ore were shipped from, and 2,000,000 tons of coal and 1,200,000 tons of merchandise to Duluth and Superior. The largest cargoes carried were 3,100 gross tons of ore, 116,000 bushels of wheat, 137,000 bushels of barley, and 1,167,000 feet of lumber, all on a draft of about 14.5 feet of water.

The *Railroad Gazette* of the 15th inst. contain an abstract of General Poe's report on the commerce through the St. Mary's Falls Canal. We add the estimated official valuation of the freight carried, viz:

ESTIMATED VALUE OF FREIGHT THROUGH THE CANAL, 1893.

Items.	Designation.	Quantity.	Price per unit.	Valuation.
Coal, hard and soft	Net tons	3,008,100	3.50	$10,528,420.00
Flour	Barrels	7,429,674	4.00	29,682,696.00
Wheat	Bushels	43,481,652	.75	32,611,239.00
Grain (other than wheat)	Bushels	2,405,244	.56	1,346,992 64
Manufactured iron	Net tons	57,046	50.00	2,852,300.00
Pig iron	Net tons	32,406	17.00	550,902.00
Salt	Barrels	228,730	1 00	228,730.00
Copper	Net tons	87,530	200.00	17,506,000.00
Iron ore	Net tons	4,014,566	3.50	14,050,946.00
Lumber	M ft., b m	588,545	18.00	10,593,810.00
Silver ore and bullion	Net tons	2,470	153.79	379,861.30
Building stone	Net tons	19,426	10.0	194,260.10
Unclassified freight	Net tons	415,180	60.00	24,910,800.00
				$145,436,956.94

The average value per ton of freight is $13.47. Freighters have held on to their trade with marked pertinacity this season in spite of the low rates. After one vessel had been floating ice bound for three days the managers of the lake and rail lines decided to keep the lake open by the use of two Detroit ferry boats, chartered at $500 a day each, until their boats should reach their destination. On the 11th inst., two steamers, loaded with coal, started from Cleveland for Escanaba, with their cargoes insured, but not their hulls, and went up through the ice reaching their destination on the 14th inst. The last boat reached Chicago on the 12th, and navigation closed at Buffalo when the Lehigh liner "Tuscarora" reached port on the night of the 16th. This closes a season remarkable for the loss of profits, vessels and lives. A table in the *Marine Review* shows that 65 vessels, with a gross tonnage of 41,625 tons, valued at $1,172,200, have been lost. As only 24,500 tons were under contract on the 15th inst. on the lakes, there will be a net reduction of freighting capacity of 17,125 tons. Efforts were also being made in Cleveland on Friday and Saturday to obtain insurance on two steamers to Gladstone for flour, an ice crusher being employed to make way for them into and out of the harbor, and these vessels cleared at midnight of the 11th inst. with insurance on cargoes but not on hulls.

South American Notes.

The proposed grand central railroad station in Buenos Ayres will not be built for some time to come, the bill for authorizing its construction having been laid aside for one year by a vote of the Argentine Senate.

It is proposed by the Argentine Minister of Finance to make all Patagonian ports from Gallegos to the Straits of Magellan free of import or export duties, imitating the policy of the Chilian government toward its Patagonian territory which has produced favorable results in the development of the country.

It is stated in the Brazilian press that the São Paulo Railway Co. has formally given up its claim to a monopoly of the traffic between Santos and São Paulo. The Mogyana Raiload will now probably be extended to the port of Santos.

The Assembly of the state of Antioquia, Colombia, has by a unanimus vote approved the edict of Governor Miguel Vasquez suspending the fulfilment of the state's obligations in reference to the contract for the construction of the Antioquia Railway. The edict alleges illegality of the contract, but suggests that indemnity for losses will be paid if the contract is cancelled. The contractors were Punchard, McTaggart, Lowthe & Co., of London.

The Peruvian government offers a substantial subsidy to any company that will run a line of steamers from the "Montana," or eastern region, via the River Amazon, to European ports. This offer is evidently made in ignorance of the depth of water available this distance up the Amazon. The most easterly Peruvian port is Iquitos, 2,400 miles from the mouth of the river. The depth to this point at normal stages of the river is only 10 ft. During the season of floods, lasting about five months, this is increased to 18 ft., but the current then has a velocity of nearly five miles an hour at points where the channel is constricted, thus negativing, to a large extent, the temporary advantage in depth.

Discussion of the suggested transcontinental railroad from Pernambuco, Brazil, to Valparaiso, Chili, still occupies the attention of various periodicals in Europe and South America. The latest suggestion is that connecting links between existing lines in Brazil should be built, and that the resulting Brazilian system should then be connected by a line through Paraguay and Northern Argentine with the Argentine systems. There is some wisdom in this proposition. At least great benefit would accrue to Brazil, from a great north and south trunk line, as we have frequently pointed out. The profitableneness of an extension to Argentine is doubtful, but the indications are that the Brazilian trunk line would pay.

The Chilian government has sanctioned the transference of the concessions for the trans-Andine railroad from Don Juan E. Clark to the Clark's Trans-Andine Railroad Company. Trains are now running daily on the Chilian end of this line from Santa Rosa to Salto del Saldado, and Mr. Clark is building a large hotel in the Andes in the unfinished gap between the two sections of the road for the accommodation of passengers in transit.

The Ecuadorian government has undertaken to have new surveys made for the long delayed extension of its one important railroad from Chimbo to Riobamba. It is stated that on the basis of these surveys a proposition will be made for a renewal of the Comte d'Oksza Orzechowskis concession to build the line, which was approved by Congress in 1890, but which ended in litigation between the concessionaries and the government.

The Buenos Ayres Great Southern Railway has decided to place five steamships in commission for the coming year to sail between its southern terminus of Bahia Blanca, Argentine, and Antwerp, Belgium. This move is made on account of the enormous increase in the exports of wheat from Bahia Blanca.

The Argentine Railroad Board has recommended to the Minister of the Interior that the Buenos Ayres & Ensenada Railway Co. be compelled to introduce the block system on its line within six months.

The report of the Córdoba & Rosario Railroad, Argentine, for the year ending June 30 last, states that the total receipts amounted to $1,217,537, the expenses being $913,967, thus leaving a net profit of $303,570. The length of line open for traffic is 180 miles. The number of passengers carried during the year was 45,140, and the freight moved amounted to 199,106 tons. The increase in receipts over those for the previous year was 47.67 per cent., and the operating expenses were reduced from 85.29 per cent. to 75.07 per cent.

The earnings of the Costa Rica Railway Co. for the year ending June 30, 18 3, amounted to $1,753,051, to which must be added $238,885 resulting from profits on the banana traffic, making a total of $1,991,936. The working expenses were $1,276,457, but the apparent profit of $715,479 was nearly all absorbed in income tax and interest on mortgages. Out of the net profits remaining $116,640 was appropriated to the second debenture holders, and the small sum of $1,543 was carried forward. The length of the Costa Rica Railway is 137 miles. The company has been authorized to issue bonds to the amount of about $500,000 to settle some outstanding claims and to build a new pier at Port Limon.

The steamer Libertador has been sent by the Colombian government to inaugurate the Orinoco navigation service between the interior ports of Venezuela and Colombia. The service will extend up the Orinoco to its junction with the Rio Meta, and thence up that river into Colombian territory to within 125 miles of Bogotá.

Railroad Securities on the Stock Exchange.

The Governing Committee of the New York Stock Exchange has listed the following securities:

Denver & Rio Grande, additional issue of first consolidated mortgage 4 per cent. bonds, $215,000, making total amount listed $28,650,000. Also an additional issue of $53,500 improvement mortgage 5 per cent. gold bonds, making total amount listed $8,103,500. These bonds are issued on account of the construction of ten miles of railroad from Crested Butte to the Ruby Anthracite Coal Mines, Colo.

Nashville, Chattanooga & St. Louis, additional issue of first consolidated mortgage five per cent. bonds, $100,000, making total amount listed $4,796,000.

Evansville & Terre Haute, additional issue of capital stock, $1,000,000, making total amount listed $4,000,000. The proceeds of the sale of this stock, $400.000, will be applied to the payment of the floating indebtedness of the company.

Milwaukee & Northern, additional issue of first consolidated mortgage six per cent. bonds of 1913. $1,089,000, making total amount listed $5,092,000. These bonds are issued for the acquisition of new property, which is subject to the lien on the mortgage.

Philadelphia & Reading, additional issue of general mortgage four per cent. bonds, $3.0.000, making total amount listed $44,663,000. These bonds are issued to take up prior liens in accordance with the terms of is subject to thethe mortgage securing them.

Clearfield & Mahoning's first mortgage 5 per cent. bonds, guaranteed by the Buffalo, Rochester & Pittsburgh on $650,000.

Chicago, Milwaukee & St. Paul, additional issue of general mortgage 4 per cent. bonds, $3,000.000, making total amount listed $14,806,000. These bonds are issued for additions to the property.

New York, Ontario & Western, additional issue of refunding mortgage 4 per cent. bonds, $875,000, making total amount listed $7,625,000. Those bonds have been issued to pay for additional equipment and other property.

Rio Grande & Western, additional issue of first mortgage 4 per cent. bonds, $1,200,000, making total amount listed $15,200,000. The proceeds of these bonds have been applied to improvements and additions to the property.

Connecticut & Passumpsic Rivers, first mortgage 4 per cent. bonds, $1,900,000.

Southern Pacific of California, first consolidated mortgage 5 per cent. guaranteed bonds, $1,000.000.

Illinois Central, 4 per cent. bonds of 1953, $21,534,000. These bonds are issued against $40,936,000 of securities of the Louisville, New Orleans & Texas Company that have been purchased.

Minnesota Railroad Commissioners' Report.

The annual report of the Railroad and Warehouse Commission of Minnesota for the fiscal year ending June 30 was submitted to the Governor on Dec. 14. The total length of railroad in the state is 5,864 miles, of which 248 miles were constructed during the year. The total gross earnings in the state were $37,087,002, showing an increase over 1892 of $908,668. The operating expenses were $22,069,724, an increase of $1,631,619. Total net earnings $15,017,278, a decrease of $722,961. The percentage of operating expenses to gross earnings was 59.50, against 56.78 for 1892. The taxes (on gross earnings) paid for the year ending Dec. 31 last amounted to $1,036,262, an increase of $153,789. The number of people killed on the cars in the state was 158 and of injured 704, showing an increase of killed of 38 and a decrease of injured of 105. The number of employes in Minnesota was 25,168, an increase of 2,386 over 1892.

Collision in Russia.

A press dispatch from Warsaw Dec. 11 reported a collision between a passenger train and a freight near Sosnowica in the government of Lublin, Russia, killing 11 persons.

The Pacific Cable Again.

The proposal by Mr. Sanford Fleming, submitted to the Canadian and Australian governments for a new Pacific cable from Vancouver to Queensland will suggest a choice of four routes, all of which will have Vancouver as the Canadian terminus. The length of the shortest route, including branches, he estimates to be 6,294 nautical miles, and the longest 8,264 nautical miles. The costs are estimated respectively at about $6,900,000 and $9,125,060. A rate of two shillings a word for transmission over the new cable will reduce the rate between Australia and England to 3s, 6d. per word in place of 4s. 9d as at present, and assuming the fixed charges to be $721,750 a year and the cable completed in 1897, he figures a deficiency of $155 000, $100,000 and $40,000 in 1897, '98 and '99 respectively. In the fourth year he makes a surplus of $10,000, which will gradually increase to $30,000 in 1906. These figures also provide for extinguishing the subsidies now paid. There is little

doubt but that a cable across the Pacific from Vancouver or San Francisco to Australia and connecting the larger and most prosperous islands is a necessity that must before long be realized. The project is certain to be opposed by the powerful influence of the company owning the existing cables between Australia and Great Britain via India, the Red Sea and the Mediterranean. It would seem that there should be a cable from San Francisco connecting with the French cable at New Caledonia, thereby effecting a saving of 800 miles. The French company is reported as being ready to continue the New Caledonia cable to San Francisco by way of the Fiji, Samoan, Fanning and Hawaiian Islands.

Shop Lighting.

Some interesting experiences in shop lighting were detailed at a recent meeting of English mechanical engineers by B. A. Dobson. Incandescent lamps are not a very great improvement over gas; while the shadows of arc lamps are so hard and strongly defined that workmen prefer a weaker illumination, if more diffused. Mr. Dobson proposes a system used on the continent, where arc lamps are used, but they are placed in an inverted position to that which is usual, the negative carbon being above and the positive carbon below. This throws the greater part of the light rays upward, as most of the illuminating power proceeds from the crater of the positive carbon. The ceiling and sides should be kept well whitewashed, so that the light thrown up will be again reflected downward. The result is that, without any definite source of illumination being observable, the whole room is flooded with a well diffused light.

Some Handsome Cars.

The following description of the compartment cars run by the Cincinnati, Hamilton & Dayton Railroad Company on the evening express from Cincinnati to Chicago has been sent to us from the Passenger Department of that company, and we reproduce it in full as describing an example of what we think is a very bad tendency toward great weight and extravagant fittings and finish, concerning which we have lately had something to say. "Not only are they architecturally ornate, but their general construction is such that the traveler enjoys the luxury of a parlor in the finest residence in the land. The cars are lighted with Pintsch gas, and there are 10 complete drawing rooms to each sleeper. This compartment communicates, except when the traveler wishes to retire or enjoy pronounced privacy, when by closing the doors a private drawing room is provided. The first room of the series is square, contains an upper and lower berth, a lavatory with white metal bowl, hot and cold water, and a good sized wicker chair, with upholstered cushions and trimmings. Despite the elaborate furnishings there is adequate room left for the occupants to move about. The exquisite coloring and decorative features are marvels of beauty. A mahogany wainscoting reaching to the height of the window sills is followed to the ceiling, including the upper berth front, by painted woodwork of pea-green striped with gold, broken by embossed and decorated plush panels to match, the latter being relieved by gold moldings. The seats of plain plush, the carpets as rich in quality as those of a Smyrna palace, and the highly embellished ceilings, in the center of which is a gas chandelier of deflecting mirrors, are each in harmony of color with the green and gold tints. Beveled glass mirrors incased in beautifully designed framework of green and gold supplant the plush panel in places convenient for the toilet—the largest mirror's handsome encasement forming a centerpiece of chaste beauty. In this and the adjoining stateroom, plate glass panels in the partition forming the aisles enable the traveler to view the scenery by pushing back the rich sash curtain drapery, which at other times secures an entire privacy of the rooms. The color of the rooms are all different, one being of white mahogany, with plush upholstering and embossed and decorated plush panels; the tints being such as to blend in a harmonious whole into that delicate shade known as canary. That the splendid equipment is meeting with public favor is evidenced by the abnormal rush that is made daily to secure berths in them in the Windy and Queen cities."

A Canal Conference.

A recent meeting of the Canal Committees of numerous boards of trade of New York State was held in New York City, the object of which was to consider the policy of the State of New York toward its canals and also the character of the improvements necessary to maintain the commerce of the canals. A letter was received from Governor Flower, expressing regret that he was not able to attend, and his interest in the object of the conference and the hope that they would make some practical suggestions relative to the maintenance and improvement of the canals. He said there was no difference of opinion among the people of the state as to the wisdom of preserving the efficiency of the Erie Canal, but gave his conviction that the best interests of the canal were not necessarily promoted by large appropriations; that it was his feeling that he had been able to save the state considerable money by refusing his signature to appropriations which were not needed, basing his act upon a personal inspection, in company with the State Engineer and Superintendent of Public Works. He expressed the belief that the principal need just now was for more rapid transit, mentioning the experiments in electric propulsion of canal boats and their success, and concluded by expressing the belief that a new life of prosperity should begin for our canals when it is abundantly demonstrated that electricity is the cheapest, the most efficient and the most practicable motive power. The letter was violently attacked by members of the conference and the Governor handled without gloves, and after a stormy debate and free discussion, was referred to a special committee to take action. The committee, after its meeting, expressed the regret of the conference at the tone of Governor Flower's letter.

A Chance for Inventors.

The Metropolitan Traction Company, of New York, has sent a letter to the Board of Railroad Commissioners offering a prize of $50,000 for the invention of a system of street railroad propulsion superior or equal to the cable and trolley systems. The Metropolitan Company says that on streets where the lines are straight and the business heavy the cable system is the most economical yet invented, but for general use in a city with winding streets following the routes of travel which the public wish to pursue it is impracticable. The belief is expressed that the only system whose entire practicability has been demonstrated is the overhead trolley, but that its adoption in the streets of New York would not be approved by the community. A working system must be submitted before March 1, 1894, to the Railroad Commissioners with the demonstration that it is superior or equal to the overhead trolley, which demonstration is left to the Board's decision. The system must be as economical as the trolley in operation, but should be without its objectionable features. No rights in the invention are exacted or expected in return for the prize, and the company refrains from having anything to do with the making of the award further than to pay any expenses that the Board may deem it necessary or wise to incur either in employing experts, or giving hearings, or in the conduct of experiments. The Railroad Commissioners have replied that while they will cheerfully co-operate with the company in every practical way, they cannot undertake to bestow the prize nor can they act as arbiters upon the merits of inventions.

Steel Barrels.

One great difficulty with barrels made of any other substance than wood is the lack of bilge and weakness of chimes. This difficulty has been surmounted by Messrs, Barraclough & Heaton, according to the *Iron and Steel Trade Journal*, in a steel barrel. Steel plates of proper thickness are stamped cold into the desired form, and the longitudinal seam is welded by electricity. The flanged heads, which are stamped with corrugations for stiffness, are forced into the ends of the barrel and are reinforced by hoops inside and out. All four thicknesses of metal are then welded together by electricity, making a strong and serviceable chime. The rings for bung and spigot holes are also welded in; for dry goods the end hole may be made very large, or a screw in head may be used. All of these barrels, it is asserted, are tested with a pressure of 40 lbs. per sq. in. for tightness. When a hole is broken in one, it can be easily repaired by welding a piece of steel over it. One great advantage of these barrels is the greater capacity for equal bulk. For instance, a barrel of the same outside dimensions as a petroleum barrel will contain 50, instead of 40 gallons; this will allow a saving of 20 per cent. in the number of barrels and in space occupied. The barrels can be tinned, galvanized, lead coated, varnished, etc. In addition to immunity from ordinary leakage, liquids transported in these barrels are apparently safe from pilfering by means of a case knife inseted in a joint between staves, or by twisting a rope around the bilge.

The Private Ownership of Freight Cars in England.

At the last meeting of the committee of the Association of Private Owners of Railway Rolling Stock, a decision of great importance to all traders owning railway wagons was come to. As is well known, the railway companies, by their standard specification for private owners' wagons, issued in 1889, and their circular as to the reconstruction of private owners' wagons, issued in April last, in effect claim arbitrary powers in respect of all such wagons. This claim is believed by private owners to go beyond the companie's legal rights, and to endanger the continued existence of private ownership in railway wagons. The Private Owners' Association, now in the third year of its existence, have, by their committee, decided that the time has come when it is essential, in the interests of trade, to get the vexed question as to the rights of owners judicially decided, so that traders may know under what conditions they will be entitled to run wagons, and how far they will be liable to have them sacrificed to the whims of wagon superintendents in the railway companie's employ before they invest further in this most useful, but under existing circumstances somewhat speculative, kind of property. An application is to be made to the Railway Commissioners immediately and their decision will be awaited with much interest.

A Danish Line to the Gulf.

Mr. Olaf E. Morgensen, C. E., of Copenhagen, Denmark, is on his way to Galveston, Tex., for the purpose of examining its harbors and jetties and obtaining information to be embodied in a report to the Free Board Directory of Copenhagen. The directory and bankers of Copenhagen are considering a steamship project between Copenhagen and the ports of the Gulf of Mexico and Mr. Morgensen is over here in their interest.

The Deepest Hole in the World.

Schladebach, in Germany, which for a long time was credited with having the deepest bore hole in the world, has more recently been outclassed by the town of Paruschowitz, in upper Silesia, at which there is now a bore hole a little over 2,000 meters, or 6,560 ft., in depth. The smallest diameter of the hole, which, by the way, has been bored with Mannesmann tubes, is 7 cm., or about 2.8 in. A series of careful temperature measurements is to be made at different depths.

Another Atlantic Cable.

The Commercial Cable Company has made a contract with Siemens Brothers & Co., of London, for a new cable between Ireland and Nova Scotia. This will make three cables owned by the Commercial Company. It is to be laid in the spring, and will be 2,200 miles in length and embody all the improvements and modern ideas in cable construction. It will have greater carrying capacity and strength than existing cables.

BRIDGE BUILDING.

Mendelssohn, Pa.—The Mendelssohn & Glassport Bridge Co., Pittsburgh, capital $5,000, has been chartered to construct a bridge across the Monongahela River from a point in Jefferson township near Mendelssohn to Point View. Directors: Ralph Bagaley, D. P. Corwin, William C. King, Pittsburgh; F. N. Hoffstot, Allegheny City; D. B. Blackburn, Jefferson township, Pa.

Williamsport, Pa.—The City Engineer is at work upon plans for a new bridge over Dougherty Run to take the place of the present structure.

Columbus, O.—The County Commissioners have ordered the County Engineer to prepare plans for the proposed viaduct over 32 tracks of the P., C., C. & St. L., B. & O., C., A. & C., and Norfolk & Western roads at St. Clair avenue in this city. Plans were to have been agreed upon, but as no conference by the roads and Commissioners has taken place since last summer, the Commissioners took this action to force matters.

Harper's Ferry, Md.—The new Baltimore & Ohio bridge at Harper's Ferry, for railroad purposes alone, will be ready for use within two months. After the new bridge is put into service all railroad travel over the old bridge will cease. The old structure will be kept open for wagons and pedestrians.

New York City.—At the meeting of the stockholders of the New York & Long Island Bridge Co., held in the offices of the Long Island Railroad Co., last week, the following were elected Directors: James G. Gardiner, George W. Quintard, James R. Cuming, Jacob P. Miller, Daniel M. Rollins, Herbert C. Smyth, William J. Kelly, William G. Bosworth, Joseph H. Jones, George A. Hamilton, Henry M. Conover, Edward J. Boyle, James J. Noonan.

Red Wing, Minn.—United States Engineer Major McKenzie has refused permission for the erection of a drawbridge across the Mississippi River at this point. The bridge will be built high enough for steamboats to pass under, and will be a wagon and foot bridge—not a combination for railroad trains.

Scranton, Pa.—The ordinance giving the city's permission to the West Ridge Coal Co. to build a bridge over the river at Green Ridge street having been signed by the Mayor, the work will now be pushed to an early completion.

St. Paul, Minn.—The City Comptroller placed in the tax budget for 1894 an item of $25,000 for a bridge over the tracks of the Great Northern Ry. at Como avenue. This has been increased by the conference committee to $33,000. The bridge will be erected early next year.

CAR BUILDING.

The Philadelphia, Reading & New England (Poughkeepsie Bridge route) placed an order last week for cabooses through the firm of Ralston & Henry, of Philadelphia.

The Long Island Railroad contract for 75 passenger cars has been awarded to the Pullman Company. No excursion or open cars are included in the order. The delivery will be made by May 1 next. The cars will have We-tinghouse brakes and Martin steam-heating system.

MEETINGS AND ANNOUNCEMENTS.

Dividends:

Dividends on the capital stocks of railroad companies have been declared as follows:

Boston, Revere Beach & Lynn, semi-annual, 2½ per cent., payable Jan. 1.

Georgia Railroad & Banking Co., quarterly, 2¾ per cent., payable Jan. 15.

Manhattan, quarterly, 1½ per cent., payable Jan 2.

New Castle & Beaver Valley, quarterly, 1½ per cent., payable Jan. 1.

New York, New Haven & Hartford, quarterly, 2½ per cent., payable Jan. 2.

Northern Central, semi-annual, 4 per cent., payable Jan. 15.

Norwich & Worcester, semi-annual, 4 per cent., payable Jan. 5.

Providence & Worcester, quarterly, 2½ per cent., payable Dec. 30.

Stockholders' Meetings.

Meetings of the stockholders of railroad companies will be held as follows:

Brooklyn Elevated, annual, Brooklyn, N. Y., Jan. 3.

Cleveland & Pittsburgh, annual, Cleveland, O., Jan. 3.

Grand River Valley, special, Jackson, Mich., Jan. 10.

Kings County Elevated, annual, Brooklyn, N. Y., Jan. 10.

New York & New England, special, New York City, Dec. 27. To consider the lease of the New York, New England & Northern.

New York & Northern, adjourned, New York City, Jan. 4.

Philadelphia & Reading, annual, Philadelphia, Pa., Jan. 8.

Rome, Watertown & Ogdensburg, annual, New York City, Dec. 28.

Western New York & Pennsylvania, annual, Philadelphia, Pa., Jan. 8.

Technical Meetings.

Meetings and conventions of railroad associations and technical societies will be held as follows:

The *Traveling Passenger Agents' Association* will hold its convention in New Orleans, La., Jan. 9.

The *Western Railway Club* meets in the rooms of the Central Traffic Association, Monadnock Building, Chicago, on the third Tuesday in each month, at 2 p. m.

The *New York Railroad Club* meets at the rooms of the American Society of Mechanical Engineers, 12 West Thirty-first street, New York City, on the third Thursday in each month, at 8 p. m.

The *Northwest Railroad Club* meets at the Ryan Hotel, St. Paul, on the second Tuesday of each month, except June, July and August, at 8 p. m.

The *American Society of Civil Engineers* meets at the House of the Society, 127 East Twenty-third street, New York, on the first and third Wednesdays in each month.

The *Canadian Society of Civil Engineers* meets at its rooms, 112 Mansfield street, Montreal, P. Q., every alternate Thursday.

The *Technical Society of the Pacific Coast* meets at its rooms in the Academy of Sciences Building, 819 Market street, San Francisco, Cal., on the first Friday in each month, at 8 p. m.

The *Tacoma Society of Civil Engineers and Architects* meets in its rooms, 201 Washington Building, Tacoma, Wash., on the third Friday in each month.

The *Association of Engineers of Virginia* holds informal meetings the third Wednesday of each month, from September to May, inclusive, at 719 Terry Building, Roanoke, at 8 p. m.

The *Boston Society of Civil Engineers* meets at Wesleyan Hall, Bromfield street, Boston, on the third Wednesday in each month, at 7:30 p. m.

The *Western Society of Engineers* meets at 78 La Salle street, Chicago, on the first Wednesday in each month, at 8 p. m.

The *Engineers' Club of St. Louis* meets in the Odd Fellows' Building, corner Ninth and Olive streets, St. Louis, on the first and third Wednesdays in each month.

The *Engineers' Club of Philadelphia* meets at the House of the Club, 1122 Girard street, Philadelphia, on the first and third Saturdays of each month, at 8 p. m.

The *Engineers' Society of Western Pennsylvania* meets at its rooms in the Thaw Mansion, Fifth street, Pittsburgh, Pa., on the third Tuesday in each month, at 7.30 p. m.

The *Civil Engineers' Club of Cleveland* meets in the Case Library Building, Cleveland, O., on the second Tuesday in each month, at 8 p. m. Semi-monthly meetings are held on the fourth Tuesday of each month.

The *Engineers' Club of Cincinnati* meets at the rooms of the Literary Club, No. 24 West Fourth street, Cincinnati, O., on the third Thursday in each month at 8 p. m.

The *Engineers' Club of Kansas City* meets in Room 200, Baird Building, Kansas City, Mo, on the second Monday in each month.

The *Engineering Association of the South* meets on

the second Thursday in each month, at 8 p. m. The Association headquarters are at The Cumberland Publishing House, Nashville, Tenn.

The *Denver Society of Civil Engineers* meets at 36 Jacobson Block, Denver, Col., on the second and fourth Tuesdays of each month except during July, August and December, when they are held on the second Tuesday only.

The *Montana Society of Civil Engineers* meets at Helena, Mont., on the third Saturday in each month, at 7.30 p. m.

The *Engineers' Club of Minneapolis* meets in the Public Library Building, Minneapolis, Minn., on the first Thursday in each month.

New England Railroad Club.

At the regular meeting on Wednesday evening, Dec. 13, 1893, President Chamberlin occupied the chair. The Secretary stated that he had communicated with Professors Swain and Allen, of the Massachusetts Institute of Technology, and the former had agreed to prepare a paper for the April meeting of the club, and the latter to prepare one for the January meeting. The Secretary also reported the result of inquiries with regard to a hall for the future meetings of the club.

The President announced as the subject for discussion at the January meeting of the club, "Railroad Building, with Reference to Economy in Operating," the subject to be opened by a paper by Prof. C. Frank Allen, of the Institute of Technology.

On motion of Mr. Adams, the Secretary was instructed by vote of the meeting to engage Wesleyan Hall, 36 Bromfield street, for the next meeting of the club.

The Secretary read the report of the Finance Committee, with reference to printing the proceedings of the regular meetings of the club, and other matters, and some discussion followed, during which the Secretary said that the Committee favored the plan of providing a light lunch to follow the discussion at each meeting. The President, representing the Finance Committee, stated that the Committee were in favor of having the proceedings of the club meetings printed and a sufficient number of copies provided to supply one to each member of the club and the other railroad clubs in the country, the reports of their meetings to be received in exchange, and he stated that advertisements to accompany the reports were to be solicited upon that basis; and on motion of Mr. Lauder, it was voted that this Club adopt this method of publishing their proceedings.

The President announced as the subject for discussion for the evening "Locomotive Boilers and their Attachments," to be opened by Mr. Stewart. An abstract will be found on another page.

American Society of Civil Engineers.

A meeting of the Society was held on Wednesday evening, Dec. 6, President William Metcalf in the chair. The paper by Howard G. Kelly, M. Am. Soc. C. E., on "The Removal of a Defective Pivot Pier, and its Reconstruction," was read by the Secretary.

A cast iron pipe, sent by Mr. Lamb, which had been in use at Cooperstown for 40 years, was exhibited.

A large album, containing 900 views in the canons of the Colorado River of the West, was presented to the Society by R. B. Stanton, M. Am. Soc. C. E.

On Wednesday evening, Dec 20, the paper to be presented was by Peter C. Haines, Lieutenant-Colonel, Corps of Engs., U. S. A., M. Am. Soc. C. E., on the "Reclamation of the Potomac Flats, at Washington, D. C.

On Wednesday evening, Jan. 3, 1894, a paper will be presented by Theodore Cooper, M. Am. Soc. C. E., entitled "Train-Loadings for Bridges."

PROPOSED AMENDMENT TO THE CONSTITUTION.

The following amendment was submitted to the Secretary on October 3 last, and, in accordance with the constitution, is now sent to the members for their information. It will come before the annual meeting for consideration:

"As provided in Article IX., Sections 1 and 2, the undersigned propose the following amendment to the constitution of the American Society of Civil Engineers:

Amend Article II., Section 9, as follows: By striking out the words "resignation has not been tendered or" and inserting after "defence," eighth line, the words *has not been*. The clause so amended will then read:

"Not less than two months after such meeting the Board of Direction shall finally consider the case, and if a defence has not been made which is satisfactory to the Board, it shall then notify the person that he will be expelled in one month, unless he elects to appeal from this decision."

ANNUAL MEETING.

The forty-first annual meeting of the Society will be held in New York, beginning Wednesday, Jan. 17, 1894, at 10 o'clock.

The annual reports will be presented, officers for the ensuing year elected, time and place for the next annual convention considered, reports of special committees presented, and other business transacted.

Thursday will be devoted to excursions. Arrangements for these and for the evenings of both Wednesday and Thursday are in the hands of a committee, and will be announced at a later date.

Engineers Club of Cincinnati.

The November meeting was well attended, there being 28 members and several visitors present. The paper for the evening was by Mr. C. N. Miller on the "Construction of the Norwood Reservoir," which is essentially a cylinder of steel plates, 40 ft. in diameter and 60 ft. high with a conical roof, resting on a concrete foundation and situated on a hill about 2,000 ft. from the site of the deep wells from which the water supply is derived. The paper was accompanied by plans and described the construction of the reservoir in detail and the formulae used in the calculations for the structure.

The next meeting, on Dec. 21, will be the annual meeting; the election of officers for the ensuing year will take place and the returning President will read a paper.

Subjects and Committees of the Traveling Engineers' Association for 1893 94.

The true and false economy in caring for, and the safe handling of, the airbrake under all conditions; and, when examining firemen for promotion, how much knowledge of the airbrake is it necessary for him to have to be considered fully competent to take a train out on the road? R. D. Davis, Chairman; T. A. Hedendahl, C. E. Weaver, C. F. Schragg, L. S. Putnam.

What are the best means of saving coal and increasing the mileage per ton, or of keeping it a ta desirable figure? M. Mast, Chairman; W. E. Chapman, J. W. Sheldon, Geo. H. Brown, P. A. Rossiter.

Testing coal in actual service; what are the easiest and most accurate methods? J. M. Hutchinson, Chairman; W. J. Anthony, C. E. Shearwood, S. W. Simonds, M. J. Reams.

What relation does a clean engine bear to the economical use of supplies? J. W. Hall, Chairman; J. B. Johnson, Chas. H. Hogan, C. W. Pool, P. E. Riley.

How can traveling engineers improve the service when engines are double-crewed or pooled? W. T. Simpson, Chairman; P. Fraser; Wm. Conger, C. M. Brinsley, J. W. Mulford.

Uniform form of examination for firemen for promotion, and new men for employment. M. M. Meehan, Chairman; J. E. Goodman, J. N. Hill, W. J. Anthony, J. W. Sheldon, W. T. Hamar.

Roadmasters' Association of America.

The next annual convention will be held in New York City in September, 1894. The following list of subjects for discussion has been prepared: (1) Records and Reports of Maintenance of Way Department.—Committee, C. S. Churchill, N. & W., Chairman; G. M. Brown, F. & P. M.; R. C. Sattley, C. & N. W.; W. H. Stearns, C. & N. W.; J. H. K. Burguin, G. & R. I., and M. J. McInarna, Inspector of Railroads in Ohio. (3) Track Joints.—R. Caffrey, L. V., Chairman; J. M. Meade, A. T. & S. F.; Jesse Supplee, Pennsylvania Railroad; R. P. Collins, O. C., and John A. Wright, C. & N. W. (3) Track Tools.—Committee: G. W. Merrill, C. M. & St. P., Chairman; Timothy Hickey, M. C.; C. A. Prentice, L. S. & M. S.; W. H. Mantz, C., S. & H., and R. Hyland, Fitchburg R. R. (4) Inspection and Distribution of Track Ties. Committee: Garrett Davis, B., C. R. & N., Chairman; M. Philbin, C., R. I. & P., M. W. Cooley, T. & O. C.; J. R. Patch, C. R. R. R., and J. R. Dickson, C. & P.

The subject selected for *Railway Age* premium contest is "Best Methods and Appliances for Clearing Wrecks."

Robert Black, Manhattan Elevated, is Chairman of the Committee of Arrangements. H. W. Reed, of Waycross, is President of the Association, and W. W. Sharpe, of Waycross, is Secretary and Treasurer.

PERSONAL.

—Dr. William S. Lawton, President of the Augusta & Savannah Railroad, was stricken with paralysis Friday last, and died in Savannah, Ga., on Dec. 17.

—Mr. Charles A. Scott, of Quebec, died last week. Mr. Scott was well known in railroad circles in Canada, and was at one time Manager of Government Railways in Nova Scotia.

—Mr. William B. Thompson, of Jackson, Mich., one of the builders of the Jackson, Lansing & Saginaw Railroad, now included in the Michigan Central, died at his home on Dec. 13.

—Mr. John M. Moore, who has for a long time been connected with the transportation department of the Charlotte, Columbia & Augusta road, has been appointed to the position of Superintendent of the Cheraw & Chester road.

—Mr. William Wainwright, the Assistant General Manager of the Grand Trunk, has returned to Montreal from his trip to the South, where he has passed several weeks for the benefit of his health. Mr. Wainwright has benefited greatly by the trip and will soon resume his usual duties.

—Mr. Epes Randolph, General Superintendent of the Chesapeake, Ohio & Southwestern, has been granted leave of absence, and the management of the property will be in the hands of Gen. John Echols, Vice-President of the railroad.

—Mr. W. E. Knox, who has been Acting Superintendent of the Alabama Mineral since the transfer of Capt. T. K. Scott to the Georgia Railroad, has been appointed Superintendent. Mr. Knox was for about three years Chief Train Dispatcher before he became Acting Superintendent in the summer. Previously he was Superintendent of the Tennessee & Coosa road.

—The appointment of Mr. J. N. Weaver as Assistant General Superintendent of the Lehigh Valley's Northern Division, which was noted a few weeks ago, was only a temporary appointment, and was made so that there might be an officer of high authority in charge at Sayre, where the principal shops are located, during the strike. When the strike was terminated Mr. Weaver returned to his position as Master Mechanic.

—Mr. George L. Lowell has been promoted to be General Superintendent of the Louisville, New Albany & Chicago, succeeding Mr. S. J. Collins, who is now General Superintendent of the Wisconsin Central. Mr. Lowell has been Assistant Superintendent and Assistant General Superintendent of the Monon route for the last three years, and was previously with the Louisville, Evansville & St. Louis as Master of Transportation.

—Mr. Arthur B. Underhill, who has been Superintendent of Motive Power of the Boston & Albany Railroad for the last 13 years, has resigned that position, his resignation taking effect on Jan. 1. Mr. Underhill has been in poor health for several years and his resignation is offered so that he may secure complete rest. He was for nearly 16 years Master Mechanic of the Boston & Worcester and in 1880 succeeded the veteran Wilson Eddy. Mr. Underhill was one of the first to build engines with boilers carrying pressures of 160 lbs. and upward.

—Mr. Walter Aiken, of Franklin Falls, N. H., President of the Mt. Washington Railroad in New Hampshire, died at Havre de Grace, Md., last week. Mr. Aiken was chiefly instrumental in carrying out the project of a cog wheel railroad up Mt. Washington, which was a conception of his father, and had been Manager of the road since 1869. He was an inventor of some reputation and took out many patents on knitting machinery. He is also credited with having much to do with the designs for the first locomotives used on the road.

—Mr. Bryan Donkin died Dec. 4 in his 85th year. He was one of the last of a group of mechanical engineers who were illustrious in the first half of this century. Mr. Donkin was especially known as a manufacturer of mill machinery and steam engines, and under his direction and at his works have been carried on many careful and highly scientific experiments and investigations concerning the generation and use of steam, which have been of great importance in the art of steam engineering. Mr. Donkin was a mechanical engineer by inheritance, his father having been the originator of the first practical continuous paper-making machine, and when he was still quite young he was apprentice to his father at the works at Bermondsey, and in these works a great part of his active life was pent.

—The attempted assassination of Mr. A. H. Watts, Master Mechanic of the Cincinnati, Jackson & Mackinaw road, last Thursday by an employee will remind railroad officers of a risk to which they are exposed in dealing with large bodies of men, some of vicious temperiment, who may be excited to rash deeds by the prospect of losing their employment. Mr. Watts very narrowly escaped being killed by a bullet from a revolver in the hands of David Calhoun, a locomotive runner whom Mr. Watts had occasion to reprimand during the day for damaging his engine. Calhoun drank heavily during the evening, and late at night went to the home of Mr. Watts, secured admittance, and in his drunken frenzy discharged his revolver at the Master Mechanic. Mr. Watts saved himself by striking the fellow's arm, and the ball pierced the wall. He then attempted to overpower his assailant, but could hardly have succeeded except for timely assistance. Calhoun is lodged in jail awaiting examination on a charge of assault with intent to kill. Mr. Watts is now confined to his house suffering from the injuries which he received in the effort to disarm his assailant.

—Col. John B. Palmer died at his Florida home near Lake Maitland, on Dec. 10, in the 67th year of his age, after a long period of failing health. Colonel Palmer's first connection with the railroad system of the South was in 1874, as President of the Southern Security Co., which company at that time controlled several of the lines now composing the Atlantic Coast Line. Upon the reorganization of this company, Colonel Palmer was elected President of the Charlotte, Columbia & Augusta Railroad in South Carolina, shortly after which he was made Vice-President of the Wilmington, Columbia & Augusta Railroad. He held both positions until the Charlotte, Columbia & Augusta Railroad withdrew from the Atlantic Coast Line, retaining the presidency of the C., C. & A., and continuing as president until that road was incorporated in the Richmond & Danville system. Colonel Palmer was then recalled to the Atlantic Coast Line system as President of the Richmond & Petersburg Railroad and Vice-President of the Atlantic Coast Line system, which positions he held until it became necessary for him to seek rest and recuperation in travel abroad. For the past few years his connection with railroad work has been only incidental. Colonel Palmer was a man of striking presence, and this, added to his superior business qualifications and high moral character, secured him immediate and successful recognition from the very beginning of his entrance into railroad life.

—Mr. C. A. Hammond, the well-known Secretary of the American Society of Railroad Superintendents, has resigned his position as Superintendent of the Boston, Revere Beach & Lynn. Mr. John A. Fenno, Treasurer, becomes Superintendent, the offices of Treasurer and Superintendent being combined to reduce expenses. Mr. Hammond began his active life as a civil engineer, having been in the employ of the State of Massachusetts several years. He has been with the Boston, Revere Beach & Lynn 14 years and has been Superintendent since 1882. The road is a short one, doing suburban passenger business chiefly, but Mr. Hammond has adapted the company's resources to its needs in a way showing both good judgment and skill in details. Many of the structures, works and methods of the road show evidence of care and calculation rather unusual in such small establishments. Since Mr. Hammond has been Superintendent the road has acquired the Boston, Winthrop & Shore, which was rebuilt under Mr. Hammond's engineering superintendence, including the Winthrop loop, which he laid out. He has also designed nearly all the stations, including the fine Boston terminal station, with its ferry slip and adjustable drop, described in the *Railroad Gazette* of Aug. 1, 1890. Mr. Hammond has been Secretary of the Superintendents' Society since 1889. He has also been for the past two years a member the Safety Appliances Committee of the American Railway Association. Mr. Hammond's address, for the present, will be 350 Atlantic Avenue, Boston.

—Mr. George H. Babcock, President of the Babcock & Wilcox Boiler Co., died at his home at Plainfield, N. J., on Saturday night, Dec. 16. The following account of Mr. Babcock's life is furnished us by an officer of the company of which he was so long the head: "Mr. Babcock was born in Otsego, N. Y., in 1832. His parents were poor, but their son had an inherited skill in mechanical invention that resulted in making him a successful business man. When comparatively a youth he started in Westerly, R. I., the first printing office in that part of the East and founded the *Literary Echo*, which is still a successful publication under the name of *The Narragansett*. Later Mr. Babcock met Charles Potter, now President of the Potter Printing Press Works, of New York and Plainfield, who was then Treasurer of the Westerly Iron Co. A partnership was formed for the manufacture of printing presses. Later this connection was dissolved, Mr. Potter taking the plant and continuing the business. Mr. Babcock came to New York and entered the employ of J. D. Stetson, a patent lawyer. During the three years that he was there he taught mechanical drawing in Cooper Union. During the following years he was connected with the Mystic Iron Works, at Mystic, Conn., and the Hope Iron Works, at Providence, R. I. He then met Stephen Wilcox, of Westerly, and with him invented the stationary engine that utilized the water-tube boiler invented by Mr. Wilcox. This invention was successfully applied to manufacturing purposes. The partnership formed by the two men continued uninterruptedly until Mr. Wilcox died, about two weeks ago. Mr. Babcock was President of the Plainfield Board of Education and largely interested in that city's affairs.

—Mr. George De B. Keim, ex-President of the Philadelphia & Reading Railroad and of the Philadelphia & Reading Coal & Iron Company, died at Philadelphia on Dec. 18. Mr. Keim was identified during almost his entire life with the Reading Railroad interests, and his connection with that company brought him into considerable prominence at various times. He voluntarily retired from the Board of Managers of the company last January and has not since been in active business life. He was born in 1832 at Reading, Pa. He studied law, and about his first practice was as counsel for coal operators in Schuylkill County, and in this position acquired an accurate knowledge of the anthracite region. In 1868 he was appointed Solicitor of the Philadelphia & Reading Coal Company, and Mr. Keim's knowledge and experience were most valuable to the county in its extensive purchases of coal lands and collieries, and the negotiations for the great estate acquired by that com-

pany, under President Gower, were conducted by Mr. Keim., In 1874 he removed from Pottsville to Philadelphia, in connection wish the Coal & Iron Company and the Philadelphia & Reading Railroad Co., and at various times filled the offices of General Solicitor, Vice President, President pro tem. and Receiver pro tem. in 1880. In January, 1884, he was made President of both companies, and in the June following, when they again passed into a receiver-ship, he was appointed by the United States Circuit Court to that position, in conjunction with Edward M. Lewis and Stephen A. Caldwell. Upon the companies resuming management of their properties in 1888, Mr, Keim was made President of the Coal & Iron Co. and also a member of the Board of Managers of the Reading Railroad Co. In the first named office he was succeeded by Mr. McLeod, and last January he retired from the second.

ELECTIONS AND APPOINTMENTS.

Boston, Revere Beach & Lynn.—Superintendent C. A. Hammond has resigned, and John A. Fenno, General Ticket Agent and Treasurer, has been appointed to succeed him. H. L. Hoyt takes Mr. Fenno's position as General Ticket Agent.

Buffalo & Southwestern.—At a meeting of the stockholders held at Buffalo on Dec. 12 the following directors were elected for the ensuing year: W. S. Bissell, E. G. Spaulding, J. M. Richmond, W. H. Newman, D. E. Bailey, Henry M. Watson, S. S. Spaulding, E. R. Spaulding, Thomas Hodgson, A. D. Bissell, Charles D. Marshall, Richard Kingman and William H. Barnes.

Cleveland, Akron & Columbus.—Charles A. Chandler has been appointed General Freight Agent, with headquarters at Columbus, O.

Cleveland, Cincinnati, Chicago & St. Louis.—James A. Gohen has been appointed Master Car Painter of this company, with headquarters at Indianapolis, Ind.

Duluth & Winnipeg.—At the annual meeting held at Duluth, Minn., on Dec. 14 the following directors were elected: H. J Boardman, Boston; Stilman Gray, Selah Van Loan, J. Hugh Peters, Charles H. John, Jr., Andrew Leitch and J. Frederick Sweasey, all of New York, and W. F. Fitch and A. B. Eldridge, of Marquette, Mich. Mr. Eldridge succeeds W. H. Fisher.

Hartford & Connecticut Western.—The annual meeting of the company was held at Hartford, Conn., on Dec. 19. The following directors were elected: A. A. McLeod, W. R. Taylor, John W. Taylor, W. W. Gibbs, Charlemagne Tower, Jr., H. O. Seixas, James Armstrong, J. H. Appleton, J. O. Phelps, Henry Gay, Frederick Niles and E. W. Spurr.

Lake Shore & Michigan Southern.—George R. Cassie has been appointed Master Car Painter of the road.

La Porte, Houston & Northern.—Charles W. Nelson, in addition to his duties as Superintendent, will also act as General Freight and Passenger Agent of this company, with office at No. 1013 Franklin avenue, Houston, Tex.

Louisville, New Albany & Chicago.—George K. Lowell has been appointed General Superintendent of the road, succeeding S. J. Collins, who on Dec. 1 went with the Wisconsin Central lines in the same capacity.

Mexican Central.—H. A. Young has been appointed Superintendent of Transportation, vice S. O. Lewis, resigned on account of ill-health. Mr. Young has for some time performed the duties of this office, during the absence of Mr. Lewis in Europe.

Mexican (Vera Cruz).—W. G. Walter has been appointed Traffic Superintendent, an office newly created. Mr. Walter will continue as one of the representatives of the London Board in his position of General Auditor.

Missouri River & Chicago.—The company has been chartered in Missouri by Charles Hammett, Lucien J. Smith, H. E. Serat, J. H. Harkless, A. D. Leech and R. C. Stripp, all of Kansas City, Mo.

Norwich & New York Transportation Co.—O. L. Johnson, Jr., Secretary and Treasurer of the Norwich line, having resigned his position after 21 years' service, the traffic duties heretofore performed by him will hereafter devolve upon C. H. Goodrich, General Freight Agent, and W. R. Babcock, General Passenger Agent, respectively. This company is controlled by the New York & New England road.

Oregon Pacific.—H. C. Day, of Portland, Or., has been appointed Agent of the company in California, to succeed D. R. Vaughan, resigned. His headquarters will be at San Francisco.

Philadelphia & Reading.—Walter Hoffman, formerly chief clerk to John W. Royer, late Superintendent of the Philadelphia & Reading Relief Association, has been chosen to succeed Mr. Royer. He has been with the company for a number of years.

Toledo, Ann Arbor & North Michigan.—General Superintendent J. B. Connors has resigned his position to take effect Jan. 1. Mr. Charles Stein will succeed Mr. Connors. The latter has been in continuous service on this road for 13 years as Train Dispatcher, Train Master and Superintendent.

Union Pacific, Denver & Gulf.—Frederick Wolfe, who has been Assistant General Freight Agent of the Union Pacific at Denver, has been appointed General Freight Agent of this road. C. F. Zimmerman, formerly Assistant General Freight Agent of the Denver & Rio Grande and later General Agent of the Atchison & Denver, has been appointed Commercial Agent at Denver.

West Shore.—C. L. Van Woert has been appointed General Eastern Freight Agent of the road, with offices at 363 Broadway, New York City, in place of Brainard Howell, resigned.

RAILROAD CONSTRUCTION,
Incorporations Surveys, Etc.

Baltimore & Ohio.—A tour of inspection has just been completed by President Mayer and other officers of the company, and the new branch lines building by the company and other improvements were carefully examined. The work at Harper's Ferry is so far along that the new railroad bridge will be open in a few weeks. The work at this point includes the re-location of the line for several miles and the building of a new tunnel in addition to the bridge work. The State line road in Pennsylvania from Uniontown to Smithfield and Point Marion, Pa., will be open within the next month. At Point Marion it connects with the line now in operation to Morgantown, W. Va. This branch reaches some excellent coal lands.

Bangor & Aroostook.—The tracklaying on this road reached Houlton, Me., on Dec. 16, the last rails to complete the road to that town being laid in a heavy snowstorm. On the same day a train was run into the town, carrying the General Manager, F. W. Cram, and other officers. Practically all of the track on the line to Houlton has been laid this year, and much of the grading, particularly on the lower section near Brownville, has been completed in 1893. The new work begins at Brownville, on the old Bangor & Piscataquis, which is now controlled by this company, and the route is northeasterly through Penobscot and Aroostook counties to Houlton, a distance of over 90 miles. That town is only the temporary terminus of the line, the objective point being Presque Isle and Van Buren, 83 miles north of Houlton. This railroad has been described frequently in these columns, and particularly in the issue of Feb. 10 last.

Belington & Little Laurel River.—The engineers are now working on the surveys for this new road in West Virginia and have the cross-sectioning finished for some distance. The road has been chartered to extend from Belington to Harding in Randolph County, W. Va., a distance of 10 miles. The work will be very easy, with only one bridge on the line, 200 ft. long. Charles Faucett, of Harding, W. Va., is the Chief Engineer. The road will be built in the interest of the United States Coal, Iron & Manufacturing Co., which owns coal mines at Harding. A meeting for the organization of the railroad company will be held at that town on Jan. 24 next.

British Columbia Roads.—Notice is given that application will be made to the legislature at the approaching session for a bill to incorporate a company to construct a road commencing at Kaslo, thence up the main fork of Kaslo Creek to Bear Lake and to the forks of Carpenter Creek.

Also to incorporate a company to construct a line from near Garry Point, on the Fraser River, in South Vancouver, to the city of New Westminster, B. C.

Central of Pennsylvania.—The first regular train over this road was run on Dec. 18 from Bellefonte to Mill Hall, Pa., 28 miles. The road extends to the Nittany Valley, a rich agricultural and mineral country from which a large traffic is expected. The line connects with the Beech Creek and Pennsylvania roads.

Charleston & Macon.—A bill to incorporate the above railroad company has passed the South Carolina legislature.

Dominion Coal Co.—The company is calling for tenders for the grading and masonry of a section of the proposed road in Cape Breton extending from a point near the Back Lands Road, Cow Bay, to a point near the end of the twenty-third mile from Bridgeport, in length about nine miles. Contractor must begin work at once on being notified of the acceptance of his tender, and must finish the work before September, 1894.

Duluth & Iron Range.—This road has found a new way out of Lake Superior's basin that will reduce its grades very materially. It will build over the new route early in the new year, somewhat lengthening its line, however.

Elkton & Southern.—The organization of a company to push the project for a road from a point on the Baltimore & Ohio through the Third, Second and First districts to a point on the Delaware Bay is assuming definite form. At a meeting of the projectors in Elkton, Md., on Dec. 12, George Biddle, Z. P. Tusby, David P. Davis, John S. Wirt, John J. Williams, H. H. Brady, George S. Wooley, Manly Drennen and Dr. Howard Bratton were elected as incorporators. The route decided upon provides that the northern terminus shall be at Childs station, on the Baltimore & Ohio road, and the southern terminus at a point on the Baltimore & Delaware Bay road. The capital stock of the new company was placed at $110,000. Dr. Howard Bratton was elected Secretary and Treasurer.

Flint & Pere Marquette.—The standard gaging of the Sand Beach Division, the line from Port Huron to Sand Beach, Mich., 70 miles, is one of the important improvements to be undertaken by this company, and it is likely to be a work of the near future. The officers have not fully decided when to make the change, but it will probably be begun next year. The work to be done is light, with no heavy or expensive bridge construction and simply involves a change of part of the ties, the laying down of new rails, resurfacing and ballasting. This the company can execute speedily with forces at its command, as it possesses tracklaying machinery and steam excavators for handling ballast, etc.

Florence, Cripple Creek & State Line.—Reports from Colorado state that the officers of this company have directed the contractor to begin active work on the line on Dec. 26, and to finish the road to the Cripple Creek mines without delay. This road is to reach the mines from the south, its initial point being at Florence, Colo., on the Denver & Rio Grande Railroad. Further details of the project and of the Cripple Creek mines are given in another column of this issue.

Fort Smith & Van Buren.—This company has filed articles of incorporation with the Secretary of State in Arkansas, with a capital of $200,000. A road will be constructed a distance of four miles between the cities of Fort Smith and Van Buren, on opposite sides of the Arkansas River in Western Arkansas, and will cross the river on a new wagon bridge.

Holston Valley.—The route of this road, now under construction, is from Bristol, Tenn., to Damascus, Va., a distance of about 30 miles. The larger part of the distance is through timber and iron ore lands. Ten miles of the road is nearly ready for the rails, and ties are on the ground for this section. The road is being built by the Willey Boom & Lumber Co. to develop its heavy timber interests and to supply the mill at Bristol with logs and to bring in iron ore, tan, bark, etc. A. T. Smalling & Co. are the contractors for the grading and trestling. The officers of the railroad are: A. F. Willey, Treasurer and General Manager; Robert Willey, Secretary, both of Bristol, and F. K. Ffolliott, Civil Engineer.

King's County Elevated.—The Phœnix Iron Company will this week begin laying the foundations for the extension of the structure of this road in Brooklyn from Montauk avenue one mile to the city line. The route will be from Montauk avenue up the Eastern Parkway to Market street and thence to the city line.

Little Rock, Hot Springs & Texas.—Uriah Lott, formerly President of the San Antonio and Aransas Pass road, is the chief incorporator of this company, which was chartered in Arkansas last week to build from Little Rock to Hot Springs, a distance of 60 miles. The project includes a line to Paris, Tex., but the first work will be on the section between Little Rock and Hot Springs. The projectors have asked the citizens of these two towns to guarantee the right of way and subscribe $100,000 to the stock of the company, and if this is done they agree to build the road within two years. J. P. Nelson, of San Antonio, Tex., is at present making the survey toward Hot Springs. The incorporators are Uriah Lott, of New York; J. P. Nelson, of San Antonio; W. J. Little, E. Hogaboom, DeWitt C. Rugg, R. L. Williams, Alf Whittington, J. J. Sumpter and C. N. Rix, of Hot Springs.

Montreal & Western.—The first through passenger trains on the road from La Chute aix Iroquois, Que., for Montreal arrived on Dec. 12. Construction work on this line is now completed, the whole 70 miles being now in operation by the Canadian Pacific.

Nevada Southern.—The annual meeting occurs in Denver this week. The road is now completed a distance of 35 miles, extending from Blake Station, Cal., on the Atlantic & Pacific, in a northerly direction. The contract for an extension of 25 miles into the Mesquit Valley has been signed and the line will be probably completed by March. This company will depend upon the resources of four promising gold camps known as the Yellow Pine, the Sheep Mountain, the Sterling and Montgomery districts.

New Mexico & Southern.—A survey for a railroad into Taos, N. M., has begun for a company not yet incorporated, which will bear the name of the New Mexico & Southern. The recent mineral developments in Northern New Mexico during the past year have induced the organization of this enterprise.

Nicola Valley.—Tenders will be received by the Secretary, J. W. McFarland, Vancouver, B. C., up to Jan. 10 for the construction of this road from Spence's Bridge to Nicola Lake, B. C. Forms of tender can be obtained on application at the company's office, 161 Cordova street, Vancouver.

Nova Scotia Coast Line.—A special meeting of the shareholders will be held at Yarmouth, N. S., on Dec. 27 for the purpose of ratifying the contract for the construction of the line from Yarmouth to Lockeport, N. S., entered into by the directors of the company.

Payette Valley & Northern Pacific.—Articles of incorporation of this company were filed last week in Boise, Idaho. This is a reorganization of the Seattle, Boise & Salt Lake Railroad scheme. The proposed line is to a point on the Oregon Short Line near Payette, in a northwesterly direction to Lewiston or Moscow, as may be determined. From Council Valley a branch is to be run into the Seven Devils country. This section is to be constructed first. About 400 miles of road is proposed in all. The directors are T. W. Bates, William Ireton and M. L. Sproat, of Payette; and Frank R. Coffin and James A. Pinney, of Boise. These gentlemen have subscribed for $400,000 of the capital stock.

Port Royal & Augusta.—The bill to repeal the charter of this company and to provide for liquidating the corporation, and for a distribution of its assets, has passed its final reading in the South Carolina legislature, and has been sent to the Governor for approval.

St. Charles Terminal.—The incorporation of the Terminal Railway Company of St. Charles was secured in Missouri last week. The company has a capital stock of $40,000, and is formed for the purpose of building a system of tracks to connect the St. Charles Car Works with the Missouri, Kansas & Texas and the Wabash railroads.

Toledo & Ohio Central.—New surveys are now being made by engineers of this company for the proposed belt line around Columbus, O. One line follows the Scioto River bank and the other the canal bank, and the proposed belt will connect the Ridgeway (or Western) Division of the road with the old main line. It starts upon the west side of the city, and connects with the old main line at Brice. It is also the purpose of the company to make more extensive yard and terminal improvements on the west side of the city than were provided for in the first plans.

GENERAL RAILROAD NEWS.

Chesapeake, Ohio & Southwestern.—The announcement was made on Dec. 19 by Collis P. Huntington that he had sold the control of the above railroad to the Illinois Central. Mr. Huntington retains his first mortgage bonds, but surrenders about three-quarters of the stock and a majority of the junior securities. The transfer is made directly to the Illinois Central, and apparently the original plan for making the payment to Mr. Huntington in notes issued by the Louisville & Nashville, guaranteed by the Illinois Central, and secured by the deposit of Chesapeake, Ohio & Southwestern stock and junior bonds, has been abandoned. The transaction now completed between Mr. Huntington and the Illinois Central in no way includes the Louisville & Nashville. What arrangement may exist between the Illinois Central and the Louisville in respect to the road cannot be learned. Mr. Huntington spoke of the transaction as follows: "I have sold my holdings in the Chesapeake, Ohio & Southwestern railroad to the Illinois Central Railroad Company for about $5,000,000. This gives the purchasers the control of the property. When I first began building the Chesapeake & Ohio Railroad and obtaining the roads west of that, I expected ultimately to get control of the Atlantic & Pacific, making a very direct line from Newport News to San Francisco by way of the Canadian Forks, River Valley & Albuquerque Railroad, and very near the line on which the last named road was actually built to Mohave, where it connects with the Southern Pacific. Some of my associates, however, did not think well of it, and my line was afterward diverted to New Orleans. This did not make the best line across the Continent, and so I thought it best to dispose of all my interests this side of the Mississippi. The Chesapeake, Ohio & Southwestern was the last link left east of the Mississippi."

Cleveland, Canton & So. Co.—The agreement for an issue of $1,100,000 receivers' certificates has now been assented to by $754,000 of the bondholders out of the $825,000 required, and by $657,000 of the creditors out of the needed $700,000.

Eel River.—Judge Capron, of Fulton County Court of Indiana, has refused the application of Judge D. D. Dykeman of Logansport, for the appointment of a receiver for this railroad, which the Wabash company has operated and controlled for a long time as part of its Detroit branch. The line extends from Logansport to Butler and is about 90 miles long.

Jacksonville, Louisville & St. Louis.—Samuel P. Wheeler, of Springfield, Ill., has been appointed Receiver of the railroad by Judge Allen in the United States Circuit Court. Mr. Wheeler's appointment takes the road out of the control of the Receivers of the Jacksonville Southeastern system, of which it is a part. The road will still be operated as a part of the traffic which that system forms.

London & Port Stanley.—The corporation of the city of London, Ont., is applying to the legislature for power to issue debentures to raise money for the renewal of the bridges, trestles and large culverts on the London & Port Stanley road, which are now wooden, or partly so. This road is controlled by the town of London.

Mexican Southern.—The reported appointment of a Receiver for this company, which was widely circulated in this country in November, is without the slightest foundation. The report has been denied in these columns, and we repeat the denial on the authority of the General Manager. The statement printed with the receivership report that the cost of repairs to the road amounted to $2,000,000 is an exaggeration. The company had considerable trouble during the past rainy season, and the road was blocked for quite a time by reason of a great many slides and a few washouts. The cost of clearing the former and repairing the latter was large, but nothing like the amount mentioned.

Oregon Pacific.—The foreclosure sale of this road, which has been so many times postponed, seems to have finally taken place at Colvallis, Ore., on Dec. 15. The purchasers were Clark & Hughes, of New York City, representing what is known as the Blair-Wharton Committee of bondholders and those who hold the Receivers' certificates of indebtedness. It is supposed that the reorganization of the company will now be carried through by the majority bondholders, represented by Mr. Blair, who has been opposed to the management in control before the receivership was resorted to.

Oregon Railway & Navigation Co.—A committee has been formed, composed of Alfred S. Heidelbach on behalf of the Deutsche Bank of Berlin; William L. Bull, George Coppell, Charles S. Fairchild and A. Marcus, representing the principal holders in Europe and America of the consolidated 5 per cent. bonds, to protect the interests of such holders in view of the default in interest due Dec. 1. In addition to the committee given, J. Crosby Brown, of Brown Bros. & Co; James Jackson, of Lee, Higginson & Co., of Boston; and Robert Fleming, of London, have been appointed by the principal bondholders of the collateral trust 5 per cent. bonds, in view of the apparently impending default in the interest.

New York & Northern.—Messrs. Drexel, Morgan & Co. have issued a circular to the second mortgage bondholders and stockholders of the company explaining the terms of the proposed reorganization of the company. The plan involves the issue of $6,200,000 4 per cent. bonds, guaranteed by the New York Central & Hudson River Railroad. Of this issue $1,200,000 will be reserved to provide for the present first mortgage, and $390,000 will be used in exchange for the present capital stock. In this exchange each 100 shares of preferred stock will receive $600 of bonds, and each 100 shares of common stock will receive $100 of bonds. Drexel, Morgan & Co. are authorized to purchase the second mortgage bonds at 80 per cent., payable in new bonds, which will draw interest from July 13, 1893.

Southern Pacific.—A statement of the earnings of the system for 10 months ending Oct. 31 shows net earnings of $14,561,065, only about $71,000 less than for the corresponding period last year. A surplus of $1,713,927 remains over all charges.

Union Pacific, Denver & Gulf.—Advices from Denver indicate that the receiver will make no changes in the operating departments, but that all former officials will be retained. The separation of the accounts of the company from the Union Pacific is the work of time and great labor. The rolling stock of the company has been scattered over the entire system, and in the matter of motive power some time is required to get the property placed. Headquarters will be established in Denver, but as the old shops of the Denver, Texas & Gulf have long ago been abandoned, it is probable that a lease of space in the Union Pacific shops at Jersey will be obtained.

Union Pacific.—The report of earnings for October is for all the roads in the system, for the purposes of comparisons, although the Fort Worth & Denver City, the Montana Union and two short branches are not operated by the Receivers. The tables of earnings follow:

OREGON SHORT LINE & UTAH NORTHERN.

October—	1893.	189 .	Dec.
Gross earning	$502,360	$680,680	$178,319
Oper. expen	296,745	385,536	128,791
Net earnings	$245,615	$295,143	$49,528
Since Jan. 1:			
Gross earnings	$5,021,177	$5,972,648	$951,470
Oper. expen	3,068,019	3,571,720	503,701
Net earnings	$1,953,158	$2,400,927	$447,769

UNION PACIFIC, DENVER & GULF.

October.			
Gross earn	$413,768	$569,209	$125,440
Oper. exp	362,487	388,929	26,441
Net earn	$81,280	$180,279	$93,999
Since Jan. 1.			
Gross earn	$4,239,002	$4,833,384	$594,381
Oper. exp	3,473,292	3,663,214	189,921
Net earn	$765,710	$1,170,169	$404,459

UNION PACIFIC SYSTEM PROPER.

October.			
Gross earn	$3,499,569	$4,493,268	$993,699
Oper. expenses	2,038,666	2,547,537	508,871
Net earn	$1,460,902	$1,945,731	$484,828
Since Jan. 1.			
Gross earn	$30,196,133	$35,469,591	$5,273,457
Oper. exp	20,692,035	22,317,724	1 625,688
Net earn	$ 9,504,098	$13,151,866	$3,647,768

TRAFFIC.

Traffic Notes.

East bound freight is very heavy on the New York Central, blockades being reported in the newspapers all along from Suspension Bridge to Boston.

A demurrage association has been formed at Sioux City, Ia. This territory has heretofore been included in the Western Car Service Association (Omaha).

The Northern Pacific lately had four train loads of live stock from Washington, Idaho and Western Montana for Chicago. These are the first cattle shipped from so far west during the winter season. The animals were fed and watered on the cars.

The railroads between New Castle, Pa., and Pittsburgh are carrying passengers to Pittsburgh and back for $1. The New Castle merchants complain at this device for taking trade away from them. Merchants along the line of the Long Island road have protested against a Christmas excursion to New York which that road has advertised for Dec. 21.

The Allegheny Valley road has made a joint tariff for coal to New England points by way of the New York Central, which it is hoped will increase the shipments from the territory along its road. An officer of the New York, New Haven and Hartford says that his road receives 200 cars of coal a week from the Lehigh Valley by floats across New York harbor.

The First National Bank of Denver has obtained a verdict in the United States Court for $2,500 against the Atchison, Topeka & Santa Fe for the value of a consignment of wines, the bill of lading of which was deposited by the consignees as collateral security. The firm failed, and the road delivered the goods to other creditors without the presentation of the bill of lading.

A Kansas jury has given a verdict for $45,000 against the Missouri, Kansas & Texas for having last May carried 2,300 head of Texas cattle from Midland, Tex., to Hartford, Kan., from the importation of which Texas fever was communicated to Kansas cattle with disastrous results. The question of law at issue is complicated, as it appears that the Kansas Live Stock Sanitary Commission had issued a permit for the cattle, and the road had complied with all the State and National quarantine laws.

On Dec. 14 the British steamship "Glenisle" sailed from Galveston, Tex., for Manchester, England, having on board the first cargo of cotton direct from the United States to Manchester through the new Manchester Canal. This shipment is a solid cargo of 4,930 bales of cotton, and is shipped by Inman & Co., of Houston, to Muir, Duckworth & Co., Manchester, England. The cotton was transferred from the compress at Houston to the vessel by barges, so that it goes from the press to the mill without the aid of the railroads. The shippers figure that the difference between the Manchester Canal toll and the railroad rate from Liverpool will reduce the freight about 35 cents a bale.

Five suits for unjust discrimination in freight rates against the Wabash, the New York, Chicago & St. Louis, the Delaware, Lackawanna & Western and the Central of New Jersey, were tried at St. Louis last week before Judge Phillips, in the United States Circuit Court. The accused parties are Milton and S. B. Knight, of St. Louis, respectively Freight Traffic Manager and General Freight Agent of the Wabash; George B. Spriggs, of Cleveland, O., General Freight Agent of the Nickel Plate; Abraham Fell, of Buffalo, N. Y., Western Freight Manager of the Lackawanna; Peter H. Wyckoff, of New York, General Freight Agent of the Jersey Central; Amos Crane and Eugene Field. The complaining parties are the American Brake Company, the M. A. Seed Dry Plate Company and the Kehlor Milling Company, of St. Louis. On the second day two of the cases were thrown out on a technical flaw in the indictments and the others were continued. Judge Phillips severely criticised the Interstate Commerce Commission and its attorneys for carelessness.

Chicago Traffic Matters.

CHICAGO, Dec. 20, 1893.

Eastern lines have agreed to restore freight rates on Jan. 1 to the basis in effect prior to the recent reductions inaugurated by the Erie, and in the interim not to further reduce rates. Notwithstanding the last clause ugly rumors are afloat that some of the lines are not living up to the agreement and further reductions may be looked for before any advance. The reductions on grain and grain products, packing house products and bulk meats made by the Erie Dec. 18 are on the basis of 17½ cents per 100 lbs. on grain and grain products; 20 cents on packing house products and 25 cents on bulk meats, Chicago to New York. The other lines, with the exception of the Lake Shore, promptly met the reductions. The Lake Shore will meet the reductions only on grain and grain products. This basis gives the following rates:

Chicago to—	Grain and grain products.	Packing house products.	Bulk meats.
New York	17½	20	25
Boston	19½	22	27
Philadelphia	15½	18	23
Baltimore	14½	17	22
Albany	16½	19	24

The reductions have been carried to the Missouri River, and Western lines are quoting 20½ cents per 100 on grain and grain products from the river to New York. The resolutions adopted by the general managers at their meeting last week are as follows:

"That all eastbound rates be restored Jan. 1, 1894, to tariffs in effect prior to Nov. 28. That no tariff be issued or rates quoted lower than the tariffs to become effective Dec. 18: That a meeting of the Western lines in the Central Traffic Association and the Trunk Lines be arranged for early next week, the Western lines joining with the Trunk lines to enter into some arrangement by which uniform export rates shall be quoted via all ports; that through the medium of some office or organization each line can have full information in regard to what others are doing in the way of shipments and rates, and that rates be maintained."

Eastbound passenger rates are the subject of a meeting of the Passenger Department in session to day, and an effort is being made to bring about a discontinuance of the payment of the excessive commissions which are being paid on every hand, notwithstanding the agreement not to do so which was made by these lines some time ago.

Such Chicago managers as have been appealed to to furnish free transportation for the unemployed have expressed the conviction that to do so would be unwise as tending to bring as many unemployed to Chicago as would take advantage of the free ride to leave the city. They are in favor of contributing to a general fund to be applied toward furnishing work for the unemployed on the streets or elsewhere, believing that such action will be more beneficial than the issuance of free transportation.

The Chicago and Ohio River lines have been again indulging in a passenger rate war, brought about by the allegation that the Pennsylvania was manipulating rates from Indianapolis to Chicago, and was also dealing with scalpers and furnishing them mileage books at a rate which admitted of their shading the rate half a cent a mile. A truce has been patched up by which it is expected that rates will be restored to-morrow to the $8 basis between Chicago and Cincinnati and $5 to Indianapolis. Judging from the past, however, there is not much likelihood of any stability in the situation.

The Chicago & Alton has given notice that it will meet the competition of the Kansas City, Fort Scott & Memphis in making holiday rates from Kansas City to Southeastern points.

The Western Passenger Association lines have joined with the Eastern lines in making a rate of fare and one-third for the holidays, inter-territorially.

The general tourist rate sheet has not yet been perfected and it is reported that some difficulty is being experienced in that direction, owing to a demand from the Fremont, Elkhorn & Missouri Valley to be allowed to quote these rates to Southeastern points via Chicago, which the other lines are unwilling to allow, because it gives opportunity for a scalp at Chicago.

The pass agreement, which has been put into effect by the Western roads under the supervision of Chairman Midgley of the Western Freight Association, provides that the issuance of annual or time passes to railroads, associations, fast freight lines, refrigerator and tank lines, and, in fact, all passes for other than political, charitable or personal purposes, shall be handled through the various committees appointed for the purpose and under the supervision of the Chairman, who is the chairman of each of such committees. Each road receiving requests for passes will indicate thereon whether it desires to issue them or not and forward the request to the committee for indorsement whether or not the passes may be legitimately issued under the agreement. If, however, the committee declines to authorize the issuance of passes which in the judgment of the managing officer of the road on which the request was made ought to be granted, the officer transmitting the request can overrule the action of the committee. The general plan of the agreement is to limit the issuance of free transportation so far as can be done with due regard to the interests of each line, and to absolutely do away with the issuance of free or reduced transportation to influence business. Unless especially authorized, passes are not to be issued to lines having a mileage of less than 25 miles, except direct connections, and lines having less than 100 miles are to receive only three annual passes The provisions of the agreement relating to the non-issuance of annual and time passes to influence business are also extended to trip passes, trip tickets and mileage tickets. Divisions of the general committee have been formed at the following points: St. Paul, Omaha, Marshalltown, St. Louis, Kansas City and St. Joseph, with a local association at St. Paul co-operating.

Eastbound shipments last week showed a large gain over the preceding week. This was influenced by the entire closing of navigation and to a considerable extent by the reduced rates in effect, shippers taking advantage of the rates before the advance, which has been agreed upon for January 1.

The Great Northern, the Union Pacific and the Northern Pacific have agreed to restore transcontinental passenger rates Jan. 1, independently of the Canadian Pacific. The latter is offered a differential via Winnipeg, but not via St. Paul as demanded. This action throws the responsibility for further disturbance on the Canadian Pacific. It is not thought that the latter will be willing to precipitate another rate war by refusing to agree.

The shipments of eastbound freight, not including live stock, from Chicago, by all the lines, for the week ending Dec. 16 amounted to 80,661 tons, against 62,266 tons during the preceding week, an increase of 18,395 tons, and against 78,443 tons for the corresponding week last year. The proportions carried by each road were:

Roads.	W'k to Dec. 16.		W'k to Dec. 9.	
	Tons.	P. c.	Tons.	P. c.
Michigan Central	15,207	18.9	10,657	17.1
Wabash	4,329	5.4	3,094	5 0
Lake Shore & Michigan South.	11,778	14.6	9,656	15.5
Pitts., Ft. Wayne & Chicago	11,634	14.4	7,556	12.1
Pitts., Cin., Chicago & St. Louis	9 357	11.5	9,365	15.1
Baltimore & Ohio	3,930	4.9	3,377	5.4
Chicago & Grand Trunk	7,627	9 5	5.716	9 2
New York, Chic. & St. Louis	4,954	6.2	3,786	6.1
Chicago & Erie	9,159	11.4	6,732	10.8
C., C., C. & St. Louis	2,686	3.2	2,327	3.7
Totals	80,661	100.0	62,266	100.0

Of the above shipments 8,964 tons were flour, 37,282 tons grain and millstuff, 12,243 tons cured meats, 11,800 tons dressed beef, 1,122 tons butter, 2,331 tons hides and 3,043 tons lumber. The three Vanderbilt lines carried 39.7 per cent., the two Pennsylvania lines 25.9 per cent.

(Other Chicago traffic news will be found on page 924.)

Westbound Trunk Line Freight.

The following table of the shipments of westbound freight, all rail, from New York by the trunk lines to points beyond their Western termini for the year ending Nov. 30, 1893, compared with the previous year, are published in the New York *Tribune*:

	1893.	1892.	Differences.
N. Y. C. & H. R.	329,439	313,616	Dec. 14,177
N. Y., L. E. & W.	330,456	337.879	Dec. 7,423
Pennsylvania	239.378	271,840	Dec. 32,462
Baltimore & Ohio	79.910	86,320	Dec. 6,410
West Shore	184,965	205,277	Dec. 20,312
Del., Lack. & W.	136,506	136,835	Dec. 329
Lehigh Valley	128,569	126,378	Inc. 2,191
N. Y., Ont. & West	20,689	26,385	Inc. 4,364
Total tons	1,459,912	1,554,530	Dec. 94,618

Division of World's Fair Traffic from New York.

A New York paper publishes the following table of the number of passengers of all classes except immigrants carried from New York, ticketed to Chicago, by the Trunk lines from April 24 to Nov. 1.

Railroads.	Excursion.	Per cent. Excursion.	Total, all kinds.	Per cent Total.
N. Y., L. E. & W.	10,400	15.6	14,390	10.6
D., L. & W.	7,929	11.8	8,920	6.5
Lehigh V.	6,860	10.3	8,377	6.2
N. Y. Central	7.455	11.1	47,730	35.5
W. Shore	10,720	16.0	12,375	9.1
N. Y., O. & W.	6 666	9.9	7,390	5.4
Pennsylvania	7,520	11.2	24,589	18.0
B. & O.	8,055	12.0	11,000	8.1
C. & O.	1,432	2.1	1,563	1.1
Totals	67,037	100.0	136,334	100.0